TESE DE DOUTORAMENTO

PHOTO ALBUM ON MOBILE DEVICES. NEW HORIZONS ON SNAPSHOT PHOTOGRAPHY

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PHOTO ALBUM ON MOBILE DEVICES. NEW HORIZONS ON SNAPSHOT PHOTOGRAPHY

D. Andrés Fraga Pérez

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PHOTO ALBUM ON MOBILE DEVICES. NEW HORIZONS ON SNAPSHOT PHOTOGRAPHY

D. Enrique Castelló Mayo

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ABSTRACT

English

Smartphones have become the leading domestic computer, reaching a percentage of the population unlike any seen before with a technological product. This ubiquity of the smartphone has also put a camera in the pockets of nearly half of the world's population, completely changing the concept of domestic photography. This thesis researches how this evolution has affected the snapshot habits of smartphone users and how it has changed the previous Kodak culture. Following the hypothesis that there is a progressive decrease in the use of traditional printed album, the objective of finding whether current photo management systems can fulfil the role that traditional album has in memory, communication and identity has been stated. A cross-study with data from user's habits, systems features and expert opinion, analysing the evolution of the situation for two years is proposed. As a result, this study finds that current systems are improving the long-term retrieval but fail concerning the implementation of standards that allow users to export the contextual information generated inside the system.

Keywords: Family album; Long-term retrieval; Metadata; Photography; Snapshot; Smartphones.

Galego

Os teléfonos intelixentes convertéronse no principal ordenador persoal, acadando porcentaxes da poboación nunca vistos antes en ningún outro produto tecnolóxico. Esta

ubicuidade do teléfono intelixente puxo tamén unha cámara nos petos de practicamente a metade da poboación mundial, cambiando completamente o concepto de fotografía doméstica. Esta tese investiga como este cambio afectou a os hábitos en fotografía dos usuario de teléfonos intelixentes e como cambiou a anterior cultura Kodak. Baixo a hipótese do progresivo desuso do álbum tradicional, fixouse o obxectivo de comprobar se os actuais sistemas de xestión de fotos en teléfonos intelixentes eran capaces de cumprir o papel que o álbum tradicional tiña na creación de memoria, comunicación e identidade. Propúxose un estudo cruzado con información de tres fontes: os hábitos dos usuarios, as características dos sistemas e a opinión dos expertos, analizando a evolución da situación durante un período de dous anos. Como conclusión este estudo atopa que os sistemas actuais están a mellorar na recuperación a longo prazo pero fallan no uso de estándares que permitan os usuarios exportar a información de contexto xerada no sistema.

Palabras Clave: Álbum familiar; Fotografía; Instantáneas; Metadatos; Recuperación a longo prazo; Teléfonos intelixentes.

Español

Los teléfonos inteligentes se han convertido en el principal ordenador personal, alcanzando porcentajes de la población nunca vistos en ningún otro producto tecnológico. La ubiquidad del teléfono inteligente también ha puesto una cámara en los bolsillos de prácticamente la mitad de la población mundial, cambiando por completo el concepto de fotografía doméstica. Esta tesis investiga cómo este cambio ha afectado a los hábitos de fotografía de los usuarios de teléfonos inteligentes y cómo ha cambiado la anterior cultura Kodak. Bajo la hipótesis del progresivo desuso del álbum tradicional, se fijó el objetivo de verificar si los actuales sistemas de gestión de fotos en teléfonos inteligentes eran capaces de cumplir el rol que el álbum tradicional tenía en la creación de memoria, comunicación e identidad. Se propuso un estudio cruzado con información de tres fuentes: los hábitos de los usuarios, las características de los sistemas y la opinión de los expertos, analizando la evolución de la situación durante un período de dos años. Como

conclusión de este estudio encontramos que los sistemas actuales están mejorando en la recuperación a largo plazo, pero fallan en el uso de estándares que permitan a los usuarios exportar la información contextual generada por los sistemas.

Palabras Clave: Álbum familiar; Fotografía; Instantáneas; Metadatos; Recuperación a largo plazo; Teléfonos inteligentes

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RESUMO

A fotografía ten evolucionado máis nos últimos vinte anos que no século anterior. A aparición da fotografía dixital a finais dos anos 90 e a súa implantación tanto no mercado profesional como no doméstico produciron radicais cambios tecnolóxicos que modificaron os hábitos fotográficos. Antes de que estes cambios puidesen estabilizarse, a aparición dos teléfonos móbiles con cámara integrada volveu revolucionar a fotografía doméstica.

A ubicuidade dos teléfonos móbiles, e máis especificamente dos teléfonos intelixentes ou *smartphones*, afecta á fotografía doméstica de dúas maneiras. En primeiro lugar, os *smartphones* son un elemento que acompaña ao usuario en practicamente todo momento, tanto fóra do fogar como dentro do espazo doméstico. Isto comporta a aparición de novas oportunidades fotográficas. Momentos ou escenas da vida doméstica que ata o de agora non se fotografaban por non dispor dunha cámara, pasan a ser retratados, polo que se documentan situacións á marxe dos eventos que tradicionalmente eran merecedores de ser fotografados e que implicaban unha mínima preparación e predisposición. Da mesma maneira, os *smartphones* non son só cámaras fotográficas, senón que tamén constitúen a principal ferramenta para revisar as fotografías, tanto propias como alleas. En comparación co álbum tradicional, este novo escenario dixital amplía as posibilidades de revisitar vellas fotografías e abre numerosas portas á posibilidade de compartir as imaxes, tanto de maneira dixital como presencialmente.

O outro aspecto da ubicuidade dos *smartphones* fai referencia á súa penetración entre a poboación. É o principal dispositivo tecnolóxico no mundo, utilizado por tres cuartas partes da poboación adulta. Este nivel de implantación é moi superior ao dos ordenadores

persoais e achega unha cámara a unha porcentaxe moi grande da poboación que nunca antes tivera acceso a ela.

Esta nova situación implica profundos cambios na fotografía doméstica en múltiples aspectos: que se fotografía, como se fotografía, para que se fotografía e como se xestionan esas imaxes. Os anteriores ciclos fotográficos, inclusive os dixitais, implicaban que o usuario fixera as fotos coa súa cámara, descargase esas fotos no seu ordenador, seleccionase e, dado o caso, editase as fotografías para despois imprimilas ou compartilas. Todo este proceso precisaba dunha infraestrutura composta de cámara, baterías, tarxetas, cables, ordenadores e controladores para poder funcionar. Esta infraestrutura está agora unificada dentro do propio *smartphone*, converténdoo na principal ferramenta para a toma de fotografías, así como no espazo onde esas fotografías se van xestionar e, finalmente, visualizar. Deste xeito, todo o *software* e procesos deseñados na primeira década da fotografía doméstica dixital ten que adaptarse a unha plataforma móbil. Isto implica cambios no deño das interfaces, na xestión de copias de seguridade e da privacidade e en moitos outros aspectos que supoñen que toda a infraestrutura ao redor da fotografía doméstica se teña que volver a organizar.

Estes dous grandes fitos, a dixitalización e a chegada dos móbiles, sitúan a fotografía doméstica nun panorama completamente novo. Este novo sistema fotográfico prescinde do seu principal sistema de xestión, o álbum de fotos –substituído, nalgúns casos, pola caixa de zapatos–. Esta ausencia de ferramentas de arquivo da memoria provoca frustración no usuario á hora de xestionar as súas imaxes persoais. Sobre este principio arranca esta investigación.

O principal obxectivo deste traballo é o de aportar unha serie de requisitos básicos que un sistema de xestión de fotografías en *smartphones* ten que reunir para dar resposta ás necesidades actuais dos usuarios. Entendemos como sistemas o conxunto de sistemas operativos, aplicacións e servizos de nube e online, e a súa interrelación. Sobre este obxectivo propomos unha serie de preguntas de investigación, sendo a principal delas se os sistemas actuais de xestión de fotografías en *smartphones* son capaces de cubrir o rol que o álbum de fotos familiar tiña na sociedade. Exponse unha aproximación

multidisciplinar, que aproveita e ten en conta tanto a bibliografía como datos de campo desde a vertente sociolóxica da fotografía, así como a aproximación a este campo que se fai dende o mundo tecnolóxico e, máis en concreto, desde o campo da Interacción Humano-Computadora (HCI). O ámbito de investigación limítase ao eido da fotografía doméstica feita con *smartphones*, deixando fóra de maneira consciente o uso amador da fotografía. No ámbito tecnolóxico trabállase sobre os principais sistemas operativos móbiles do mercado: Android, iOS e Windows Phone.

As hipóteses da investigación son:

- Os actuais sistemas de xestión de fotos en *smartphones* non funcionan como ferramentas de memoria a longo prazo. Os *smartphones* convertéronse na cámara principal da maioría dos usuarios e ao mesmo tempo na principal ferramenta de consumo audiovisual. Por este motivo, os usuarios deben ser quen de manexar as fotos persoais desde a creación ao seu uso final, así como permitir a súa recuperación e revisión nun futuro. Cremos que as solucións existentes, tanto en sistemas operativos como en aplicacións, non teñen en conta o factor a longo prazo da forma en que o facían os álbums de fotos tradicionais.

- O número, cada vez maior, de fotografías que os usuarios xestionan nos *smartphones* fai que proceso de curación, para separar as imaxes relevantes, sexa moi complexo.

- Os sistemas non están a proporcionar aos usuarios as ferramentas adecuadas para un proceso de curación fácil. Os sistemas non están considerando a tipoloxía, fonte e autoría das diferentes imaxes que os usuarios teñen nos seus dispositivos para así facilitar a súa curación.

- Os sistemas non están a usar metadatos normalizados para enriquecer o contexto das fotografías. Os teléfonos intelixentes son ferramentas capaces de crear información contextual ao redor dunha fotografía, ao engadir información sobre a hora e o lugar en que a imaxe foi tomada.

- O procesamento intelixente de imaxes posibilita engadir máis información sobre os obxectos e as persoas nas imaxes, creando un contexto arredor de cada imaxe ou coleccións de imaxes. Non obstante, esta información non se está a anexar ao arquivo fotográfico de forma lexible para ser empregados por outros sistemas e servizos.

Sobre esas hipóteses deseñouse unha metodoloxía de investigación baseada en tres pasos, que representan tres puntos de vista sobre a mesma problemática: a visión dos usuarios, a visión da industria e a visión dos expertos. Coa visión dos usuarios o que buscamos é comprender cales son as necesidades e problemáticas que os usuarios teñen ao redor da xestión das súas coleccións de fotos persoais nos seus teléfonos móbiles. Coa visión da industria, buscamos recoñecer que solucións ofrecen os diferentes sistemas ás necesidades que os usuarios formularon, e para iso deseñamos un banco de probas no que simulamos unha colección de fotografías nun teléfono e observamos como os diferentes sistemas reaccionan e cales son as opcións que ofrecen. Finalmente, coas conclusión preliminares destas dúas visións, consultamos a un panel de expertos de diferentes ámbitos pero con experiencia recoñecida no campo da fotografía doméstica co fin de, por unha parte, verificar as conclusións obtidas previamente e, por outra banda, mellorar a visión transversal e multidisciplinar dos resultados e obter mellores conclusións.

Para a primeira parte da nosa investigación, a visión dos usuarios, deseñouse un cuestionario que buscaba obter a visión dos usuarios, pero tamén resolver unha serie de hipóteses previas produto da experiencia persoal e colectiva na xestión de coleccións persoais de fotos. Estas hipóteses sinalan que os usuarios teñen moitas fotografías nos seus *smartphones*, máis das que son capaces de xestionar. Reflicten tamén que os usuarios teñen máis dunha fonte para as súas fotografías, e que estas xa non proveñen exclusivamente da súa cámara, o cal leva a afirmar que teñen máis fotografías das que eles mesmo fixeron. Ademais, os usuarios non teñen a súa colección actual de fotografías nun só espazo e contan con máis fotografías das que poden realmente revisar.

A enquisa estrutúrase en catro apartados. Primeiramente, un bloque con información persoal, con preguntas relativas á idade, xénero e composición da unidade familiar (en concreto, a existencia de fillos menores de idade), polo influencia que estas características

poden ter na dedicación á curación de seu arquivo dixital. Finalmente pregúntase que experiencia teñen co uso dun *smartphone*. O segundo apartado céntrase na tipoloxía de imaxes que os usuarios teñen nos teus teléfonos. Pregúntase pola autoría das mesmas, a través de que aplicación entran as imaxes no teléfono e en que situacións usan a cámara. O terceiro apartado afonda nos sistemas que os usuarios utilizan para xestionar as súas coleccións nos seus teléfonos, con preguntas sobre onde teñen actualmente a súas fotos, que nubes utilizan, que redes sociais usan, que fan cando teñen algunha foto especial e se revisan as imaxes que teñen no seu teléfono. O último apartado céntrase no uso do álbum tradicional e nas expectativas dos usuarios acerca da posibilidade de revisar as fotografías que fan cos seus teléfonos nun futuro.

Os resultados desta enquisa corroboran case todas as nosas hipóteses. En primeiro lugar, observamos como os usuarios de *smartphones* utilizan as cámaras dos seus teléfonos para máis usos fóra dos tradicionais eventos fotografables, e como esta situación vaise facendo máis evidente canta máis experiencia co uso do *smartphones* se ten. Estes novos hábitos xeran novas imaxes que non sempre teñen o valor que tiñan as fotografías familiares. Un exemplo disto é a fotografía da contrasinal da wifi nun *router* doméstico. Outro dos aspectos destacables é a variedade de fontes de entrada de imaxes nos *smartphones*, sendo moi minoritario o número de usuarios que só teñen fotos feitas por eles. Isto abre a porta a ter en conta novas variables á hora de organizar as imaxes, xa que a metadata do sistema adoita basearse en datos de captura e localización, e os novos sistemas de Intelixencia Artificial poden xerar metatada sobre as persoas ou obxectos, incluso situacións, que aparecen nas fotos, pero ningún sistema captura ou xestiona información sobre a autoría da fotografía.

A enquisa tamén debuxa un panorama complexo na xestión actual das coleccións fotográficas, que se atopan diseminadas ente diferentes dispositivos e soportes. Ademais, estes soportes son en ocasións pouco seguros como método de almacenaxe a longo prazo, como é o caso dos ordenadores e os discos duros. Se analizamos todos os elementos contidos na enquisa, percibimos unha complexa rede na que os usuarios teñen moitas fontes de entrada de imaxes, de moitas tipoloxías distintas, para moitos usos diferentes e en soportes variados. Esta situación de complexidade é común a todos os grupos de idade,

xénero e experiencia. A única hipótese que non se viu refutada é a relativa á visión das fotografías nos teléfonos, xa que a maioría dos usuarios afirman revisar todas as fotografías dos seus dispositivos, o que reforza a necesidade de que os sistemas sexa capaces de ofrecer unha completa experiencia de uso, tamén a longo prazo, dentro do propio *smartphone*.

Un dato que nos resultou moi interesante foi a reacción dos usuarios fronte a unha imaxe de especial valor. A segunda opción, despois de gardala no ordenador, é a de imprimila. Este resultado é constante en case todos os grupos de idade menos nos máis mozos, que usan as redes sociais, e os maiores, que optan exclusivamente por gardalas no ordenador. Esta información manifesta que ante unha imaxe de especial relevancia unha das principais solucións segue a ser completamente analóxica. Cando nos fixamos no uso actual do álbum de fotos impreso, vemos como menos da metade dos usuarios seguen a imprimir álbums e, se a ese grupo sumamos as persoas que imprimen álbums pero non usan as fotos dos seus *smartphones*, a porcentaxe de usuarios que imprimir álbums coas fotografías do seu teléfono cae a un terzo. Interésanos especialmente ese colectivo que, a pesar de facer o esforzo de salvagardar as súas fotos, non ten en conta as imaxes dos seus dispositivos móbiles.

Como conclusión preliminar deste estudo sobre os hábitos de xestión de fotografías nos *smartphones* cabería destacar como a ubicuidade dos móbiles xera novos usos fotográficos, que incrementan a complexidade na xestión con novas tipoloxías, fontes e autores na fotografía doméstica. Propomos indagar máis sobre as posibilidades de incluír a autoría das imaxes como un elemento máis á hora de xestionar as coleccións de fotografías. Destacamos tamén a falta de uso e confianza que os usuarios teñen nos servizos de nube a e necesidade de mellorar estes datos para unha correcta transición cara un sistema completamente móbil, xa que a maioría dos usuarios non teñen ningunha copia impresa das súas fotos feitas con móbil e confían exclusivamente en sistemas dixitais para a súa conservación a longo prazo. Finalmente, a falta de confianza nos actuais sistemas xera frustración entre os usuarios.

No segundo capítulo desta investigación analizamos as opcións que os diferentes sistemas ofrecen para xestionar coleccións de fotos en *smartphones*. De cara a obter unha mellor visión sobre un sector en continua e rápida evolución como é o dos servizos móbiles, propomos un estudo no que, en dous períodos separados por vinte meses, enfrontamos os diferentes sistemas escollidos a unha serie de preguntas sobre as opcións que os usuarios teñen á hora de xestionar as súas imaxes, baseadas nas conclusións do capítulo anterior.

Na selección dos sistemas optouse por integrar os exemplos máis significativos dos diferentes servizos que operan na xestión de fotografías no teléfono móbil. Desta maneira, escolléronse os servizos integrados dentro dos tres principais sistemas operativos móbiles, Android, iOS e Windows Mobile, así como as opcións de plataformas de almacenamento na nube como Dropbox e Amazon e as redes sociais específicas de fotos como Flickr. Ao mesmo tempo, decidiuse estudar como estes sistemas funcionaban sobre as diferentes plataformas.

Unha vez recollida a información dos dous estudos formulados, un dos elementos máis destacados é a clara evolución dos sistemas no período estudado. A maioría dos sistemas analizados melloraron os seus servizos ao mesmo tempo que a experiencia de usuario tendeu a homoxeneizarse, xa que as mellores características de cada un dos servizos foron adoptados polo resto. Neste período tamén vimos como algúns servizos desaparecían e outros cambiaban de nome ou funcionalidade. É destacable como o sistema operativo Windows 10 Mobile practicamente desapareceu no período estudado.

Entre os resultados destacamos a necesidade de sistemas de sincronización automática das fotografías dos *smartphones* e como a maioría dos sistemas o integraron, pero tamén son destacables as limitación que os sistemas teñen baixo a plataforma de iOS para poder facer esta acción en segundo plano sen a intervención do usuario. Da mesma maneira, é moi destacable o esforzo que moitos dos sistemas teñen feito para ofrecer a posibilidade ao usuario de seleccionar que imaxes quere sincronizar e cales non. Este sistema, escollido por Google Photos inicialmente e posteriormente por OneDrive e PrimePhotos, permite un primeiro filtrado das fotos a salvagardar, e elimina do proceso

de xestión un primeiro grupo de imaxes xeradas por algunha aplicación que o usuario xa sabe que non quere gardar. Porén, este sistema de cribado non pode ser aplicado por ningún sistema dentro de iOS, xa que forza a todos os sistemas a utilizar unha única galería de imaxes, impedindo así eliminar unha aplicación especifica da sincronización.

Outro dos aspectos a destacar é como todos os sistemas evolucionaron ata converterse en servizos de almacenamento na nube, no senso de que todos copian as fotos dos *smartphones* a un servidor remoto. A principal diferenza xorde á hora de xestionar as imaxes na nube, no tipo de servizos que ofrecen e no nivel de acceso ás fotografías. Comprobamos como non todos os sistemas ofrecen unha experiencia de visualización unificada entre diferentes plataformas (*smartphones*, tabletas, televisións e ordenadores) e como isto pode afectar á visualización das imaxes e á integración das novas imaxes feitas con móbiles, coas feitas con cámaras de fotos dixitais e coas coleccións previas.

Un punto de especial interese para nós é o referente á metodoloxía de organización das fotografías. A creación de seleccións de imaxes de maneira automática é unha potente ferramenta para axudar ao usuario no comisariado da súa colección. Aínda así, sistemas como o de Apple, baseado principalmente na creación de eventos, presenta dificultades con novas tipoloxías de imaxes que están fóra dos eventos tradicionais das fotografías domésticas. Así mesmo, solucións como as de OneDrive, que xera un álbum por cada semana ou fin de semana, producen unha información excesiva. Por outra banda, vemos como solucións coma a proposta por Google Photos, que crea álbums con seleccións de fotos baseadas en algoritmos máis complexos, ofrece ao usuario unha proposta de organización que ten un valor. Aínda así, os usuarios deberían ter a posibilidade de crear e modificar os automatismos dos sistemas e de navegar entre as imaxes de xeito máis fluído.

Outro dos elementos no que centramos a nosa atención é a capacidade dalgunhas imaxes para actuar como activadoras da memoria. A opción Flashback introducida por Carousel é unha ferramenta efectiva para animar ao usuario a revisitar as súas imaxes, e é significativo que o resto dos sistemas optasen co tempo por incluílo. Con todo, e unha

vez máis, a creación destas notificacións tense que facer en base a criterios válidos para o usuario, ou converteranse en notificacións molestas que perderán a súa efectividade.

No referente á opción de compartir, identificamos dúas metodoloxías básicas. Por unha parte, a opción de descargar a imaxe orixinal no teléfono para compartila con outro usuario, ben a través do sistema operativo ou dalgunha outra aplicación. A segunda opción permite compartir a imaxe dentro do propio sistema, a través dunha ligazón ou dunha notificación. Neste segundo caso, a fotografía pode compartirse de maneira restrinxida a certos usuarios específicos, ou de maneira aberta a aqueles que teñan a ligazón. Cada unha destas metodoloxías implica distintos graos de accesibilidade ás imaxes, así como diferencias no control de propiedade.

Por último, no que se refire á metadata, identificamos tres tipoloxías: a xerada pola cámara, a xerada polo usuario e a xerada polo sistema. No primeiro caso, os sistemas recollen toda a información que a cámara do *smartphone* lles ofrece, normalmente no estándar Exif. No segundo caso, inclúese toda a información que o usuario pode engadir a unha fotografía. Esta normalmente consta de datos de contexto, similares ás anotación que anteriormente se facían nos álbums familiares, pero tamén temos en conta nesta categoría a propia selección das fotos en coleccións ou álbums. Finalmente, a metadata xerada polo sistema agrupa todas a informacións que o sistema crea en base ás imaxes do usuario. Estes datos poden derivar de etiquetas xeradas de maneira automática con métodos de intelixencia artificial, do recoñecemento facial ou da creación de álbums ou coleccións automáticas.

Todos os sistemas analizados xestionan os tres tipos de metadata pero difiren especialmente na maneira de xestionar a creada polo usuario e polo sistema. No referente á información do usuario, non todos os sistemas permiten crear ou editar a información sobre etiquetas ou a descrición da imaxe. No relativo á información creada polo sistema, nalgúns casos esta é opaca para o usuario e non existe a posibilidade de ampliala ou modificala.

Como conclusións provisionais desta parte da investigación destacamos a importancia da diferenciación das tres tipoloxías de metadata, así como a ausencia de

estándares de metadata como o Exif ou o IPTC, especialmente na metadata xerada polos sistemas. Igualmente, a imposibilidade de edición desta información limita o seu uso, dado que inevitablemente aparecerán incorreccións, tendo en conta a natureza polisémica da imaxe. Destacamos tamén a importancia de ofrecer ao usuario a posibilidade de escoller que fontes ou tipoloxías de imaxes quere sincronizar co sistema, e como os procesos de comisariado automático teñen que ser relevantes para o usuario. Finalmente, introducimos a necesidade de habilitar regras que permitan ao usuario personalizar que contido desexa sincronizar e de posibilitar a xeración automática de etiquetas personalizadas que utilicen metadata existente.

No capítulo final desta investigación enfrontamos as dúas visión previas, a do usuario e a dos sistemas, coa opinión dun panel de expertos procedentes de diferentes campos, pero todos eles con ampla experiencia na xestión de colección de fotografías persoais. O obxectivo deste panel de expertos era o de corroborar as nosas hipóteses previas cunha visión a longo prazo e ver como eran vistas desde diferentes campos de investigación. De cara á creación do panel de expertos escolléronse perfís do ámbito académico e do eido industrial, todos de sobrada solvencia profesional e experiencia na xestión de fotografías domésticas. Finalmente, os expertos que participaron foron Richard Chalfen, profesor emérito de Antropoloxía da Temple University de Philadelphia e autor de *Snapshot Versions of Life*, libro de referencia no estudo da fotografía doméstica; Risto Sarvas, investigador da Aalto University de Helsinki e autor de *From Snapshots to Social Media - The Changing Picture of Domestic Photography*, quen é especialista en metadata de imaxes de móbiles e ten estudiado os modelos de negocio das empresas fotográficas; e Jessica Bushey, arquivista no North Vancouver Museum and Archives e profesora na University of British Columbia. No campo da industria, contamos coa colaboración de Juha Alakarhu, vicepresidente de Imaxe de Axon e antigo xefe de Tecnoloxía da Imaxe en Nokia e Microsoft, con vinte anos de experiencia no deseño e dirección de ferramentas e servizos para fotografía móbil. Finalmente, incluímos a Joshua Fagans, enxeñeiro informático que traballou no desenvolvemento das aplicación de xestión de fotografías de Apple desde a fundación de NeXT por Steve Jobs. Joshua estivo involucrado no

desenvolvemento de iPhoto e Aperture. As entrevistas con Risto Sarvas e Juha Alakarhu fixéronse de maneira presencial en Helsinki e o resto a través de correo electrónico.

De cara a optimizar o tempo dispoñible con cada un dos expertos, organizáronse as preguntas en cinco grupos: Escenario complexo, Operacións de sistema, Falta de confianza, Álbums e familia e Metadata. As preguntas construíronse a partir dos resultados dos primeiros dous capítulos do traballo. Aínda que tratan temas comúns, oriéntanse ao campo en que cada un dos expertos ten máis experiencia.

Do primeiro grupo de preguntas, as relativas ao incremento da complexidade dos sistemas, os expertos coinciden en que existe un interese xeral por parte dos usuarios en conservar as imaxes dos seus teléfonos, así como na frustración que provocan as dúbidas sobre a eficacia dos actuais sistemas para a conservación das imaxes a longo prazo. Ao mesmo tempo, reafirman a existencia de novas tipoloxías fotografías que supoñen novos usos. A aparición destes novos usos está ligada á evolución da tecnoloxía fotográfica.

No relativo ás operación dos sistemas, os expertos corroboran a importancia dunha navegación fluída entre as fotografías, aínda que existe algunha discrepancia entre a vixencia do sistema de Eventos, que nós consideramos obsoleto. Si que coincidimos con eles na importancia de dotar ao usuario de máis control sobre as súas coleccións e de mellores ferramentas para decidir que se arquiva e que non. Neste senso, propomos unha estrutura para que os sistemas organicen a captación, filtrado, documentación e organización das fotografías, relacionando este sistema co futuro desenvolvemento do Data Transfer Project. Os expertos tamén coinciden na importancia de implantar un sistema de notificacións que sexa efectivo e relevante para o usuario.

Levando a discusión ao ámbito do álbum familiar, buscabamos coñecer a opinión dos expertos acerca das posibilidades actuais de crear un espazo fotográfico familiar. Coincidimos na importancia destes espazos, para os cales os actuais servizos seguen sen aportar solucións convincentes. Neste punto, Sarvas introduce a discusión sobre se os grupos familiares de WhatsApp están a funcionar como álbums fotográficos. Pola súa banda, Chalen e Bushey subliñan as limitacións que esta rede social presenta na xestión da información contextual e da relevancia das imaxes, así como a súa deficiente

capacidade arquivística. Neste senso, concluímos a importancia de afondar no estudo de WhatsApp como ferramenta de álbum familiar polo seu amplo uso entre todos os grupos de usuarios e pola riqueza da súa información contextual.

Un dos resultados máis inesperados da primeira parte do noso estudo foi que máis da metade dos participantes perdera a esperanza de preservar as fotografías do seu teléfono no longo prazo. Neste senso, obtemos diferentes puntos de vistas dos nosos expertos. Bushey e Chalfen opinan que efectivamente se perdeu esta visión de longo prazo, aínda que difiren sobre a importancia que para o usuario teñen esas fotos. Fagans subliña que esas solucións aínda están por chegar. No relativo á confianza dos usuarios nos almacenamentos na nube, os expertos coinciden na importancia de que o usuario conte cunha copia da súa colección fotográfica.

No referente á metadata das imaxes e á xestión da información contextual, coincidimos cos nosos expertos en que a metadata é o mellor espazo para aloxar a información contextual das imaxes. Sae tamén a colación nesta discusión a necesidade de incluír nesa metadata información contextual que no álbum de fotos tradicional existía de maneira oral, e reforza a nosa idea de que o usuario ten que ter a posibilidade de modificar ou enriquecer esa metadata. O uso de estándares constitúe outro punto de acordo, dada a necesidade de facilitar que a información contextual funcione tanto no logo prazo como fóra do sistema no que foi creada.

Logo destas tres visión, a do usuario, a do sistema e a dos expertos, estre traballo aportas as seguintes conclusións:

1. A hipótese de que as solucións actuais de xestión de fotografías para dispositivos móbiles non funcionan como ferramentas de memoria a longo prazo non foron validadas completamente, xa que algúns dos servizos incorporaron con éxito ferramentas para a recuperación de imaxes. Tamén se observou como os sistemas foron integrando diferentes métodos de notificacións que poderían facilitar o seu papel na conservación da memoria. Non obstante, non incorporan o contexto humano necesario para crear reminiscencias e recuperación.

2. Os sistemas non forneceron ferramentas para clasificar e filtrar o número de imaxes entrantes nos teléfonos intelixentes. Só proporcionando a opción de filtrar por fonte, os usuarios non poden manter as súas coleccións de fotos limpas de información non relevante. Unha vez que as imaxes son sincronizadas cos sistemas, a solución actual para a selección e filtrado parece insuficiente para separar as imaxes relevantes das que non o son.

É imprescindible mencionar que servizos como Google Fotos, Prime Fotos e OneDrive lograron importantes avances neste senso. Tamén é importante resaltar as limitacións que presenta iOS. Con só unha galería fotográfica, crea problemas graves ao non dar a ningún sistema a oportunidade de filtrar por orixe. Consideramos esta limitación como un fallo crítico.

3. É imprescindible crear filtros máis avanzados e personalizados para separar as imaxes relevantes das que non o son e isto debería facerse antes de que entren todas no sistema. Os sistemas tamén deben permitir a integración de información sobre a orixe das fotos como unha tipoloxía de metadatos, permitindo ao usuario e aos sistemas usar unha fonte non só como filtro senón tamén como parámetro de busca. Tamén deben proporcionar ao usuario toda a información dispoñible para crear protocolos e automatismos para accións como a creación de etiquetas, a creación de álbums e o filtrado.

4. A maioría dos sistemas inclúen procesamento de intelixencia artificial na creación de etiquetas. Estes procesos traballan de xeito eficiente identificando obxectos, persoas e algúns eventos como vodas e aniversarios. Non obstante, esta información non se almacena na imaxe como metadatos normalizados e non é posible que o usuario a exporte. Os usuarios deberían ter acceso a toda a información contextual almacenada polos sistemas, así como á información resultante do procesamento de metadatos anteriores.

Manter esta información ligada a unha plataforma pode parecer unha excelente estratexia para reter ao usuario nunha plataforma específica, pero compromete a recuperación a longo prazo da información contextual da imaxe. Esta estratexia pon en

risco o papel da fotografía como ferramenta de creación de memoria. Por iso, cómpre unha lexislación específica para protexer o interese do usuario.

5. A elaboración de sistemas AI está a desenvolverse para evitar a necesidade do comisariado humano. Non obstante, os sistemas deben permitir aos usuarios engadir, editar e eliminar a información contextual creada por AI, xa que o sistema pode equivocarse ou porque hai información valiosa á que os sistemas de AI non poden acceder ou que non comprenden. O procesamento de IA tamén debe poder aprender dos hábitos e preferencias do usuario.

6. A maioría da investigación no eido da imaxe xira en torno aos teléfonos intelixentes e os seus ecosistemas, pero aínda queda por investigar como incorporar as coleccións dixitais anteriores e as fotografías analóxicas dixitalizadas aos sistemas actuais. Os sistemas implementaron algunhas ferramentas para respectar a organización anterior en cartafoles, como é o caso das Prime Fotos, ou para dixitalizar imaxes de papel antigas, como Photoscan de Google, pero estas solucións non se estenderon ao resto dos sistemas e seguen estando lonxe de ser efectivas.

Design should not dominate things,

not dominate people,

should help people

Dieter Rams

To Mariña and Leda.

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CONTENTS

CHAPTER 1 INTRODUCTION

1.1. BACKGROUND

In the last 20 years, photography has experienced more changes than in the previous century. KODAK business model led the way of how photography was understood, both in the professional and the domestic environment. However, if we analyse these years, little changes were made, as most of the technological development was focused on improving a system based on buying film and developing it in a lab (Sarvas & Frohlich, 2011).

It was in the late 90s and in the beginning of this century when more dramatic changes were made with the arrival of digital cameras. Professional photographers, and more specific, press photographers, were the first in noticing the changes that digital photography was bringing (Hadland, Cambell, & Lambert, 2015). As early as 1994 Associated Press together with NIKON and Kodak developed the NC2000, a NIKON N90 film camera with a bulky KODAK digital back. It was used to cover the Winter Olympic Games in Norway that year. One year later CANON had his version as the EOS DCS 3. CANON EOS D2000, with a CCD sensor capable of producing 1.3 megapixels, reached the market in 1998. It was a model that fitted well in the workflow of photojournalist both due to his image size and its working speed. With a launching price of 1.980.000 yen, a current equivalent to 16.500€, it started to be frequent between photographers from agencies and leading newspapers, but it was too expensive for smaller newspapers and

Figure 1: Canon EOS D2000. (© Canon Inc. From Canon Camera Museum. https://global.canon/en/c-museum/product/dslr777.html)

agencies (Caballo, 2006). Just two years later, CANON announced the EOS D30, a less professional camera, but with a sensor capable of creating images of 3,25 million pixels and with a launch price five times lower that its predecessor. That pushed de digitalisation of smaller newspapers. It is noteworthy that the last 35mm film professional camera presented by CANON was the EOS-1V, in the year 2000 (Canon, 2019).

This digitalisation of photography led to radical changes in the field of professional photography, but most of those changes were also applied, at nearly the same time, to domestic users. Digital consumer cameras reached the market with very little difference in time that the product we have just seen, and prices started to drop very fast as the digital

cameras became more and more a consumer's product. This digital conversion reduced the technological barriers that professional photography had before, merging and unifying infrastructures that used to be totally different before (Sarvas & Frohlich, 2011). However, long before this new landscape was even close to being established, the arrival of smartphones, ten years later, disrupted photography again. On this occasion, the main changes came directly to domestic users. Moreover, at this time they were nearly ubiquitous, as they came hand in hand with the development of smartphone technology.

Mobile phones, and to be more accurate, smartphones, have grabbed the attention of all the tech industry in the last ten years. One of the reasons for that interest, and the main difference with other technological products, is that smartphones are making technology universal. In the words of Benedict Evans:

> … we sold mainframes to big companies, we sold pc to middle-class families, we sold technology in one way or the other to a segment or portion or subset of the population, but mobile is a product that gets sold to pretty much everybody on earth. And that is really the first-time technology is doing that, and that is a fundamental change (Evans, 2015)

Mobile devices and, more specifically, smartphones have become the primary tool for Internet use, and therefore, the most used "computer" at homes. Besides, mobile devices are used not only for "mobile" activities that take place outside our home or office, like checking a map or taking a photo, they are also used at home and office, even though the user might have a pc switched on just in front of him (Ofcom, 2015). That means that many of the domestic tasks that were previously done on a pc or a laptop at home are now being done on a smartphone or tablet. In addition, this can be extrapolated to the use of a camera, as many users will prefer to use their smartphone camera even though they might have a digital camera with them.

For those reasons, smartphones have become the most ubiquitous technology (Castelló-Mayo, Mendez, Lopez, Flores, & Sanchez-Vila, 2016), and they have done it in two ways. Firstly, because the mobile phone goes nearly everywhere the user goes,

both inside and outside the domestic space (Ofcom, 2015). Secondly, because it has reached an unprecedented percentage of the population that cannot be compared with any other technology or electronic product. It is estimated that three-quarters of the adult population will have a smartphone by 2020. This percentage is much higher than the pc reach, making smartphones and tablets the central domestic computer (Evans, 2015).

Twenty four million cameras were sold in 2017 (CIPA, 2018), versus 1.5 billion smartphones sold the same year (Framingham, 2018). In 2015, around 2 billion photos were uploaded every day to FACEBOOK (Bandaru & Patiejunas, 2015), and that is only a percentage of the photos that were uploaded to the net, and a small portion of the photos taken with smartphones. A study made in the UK concluded that six out of ten adults use their mobile phone to take photos more often than other cameras (Ofcom, 2015). With this data, it is possible to work under the assumption that most of the pictures taken today on Earth are made by mobile phones.

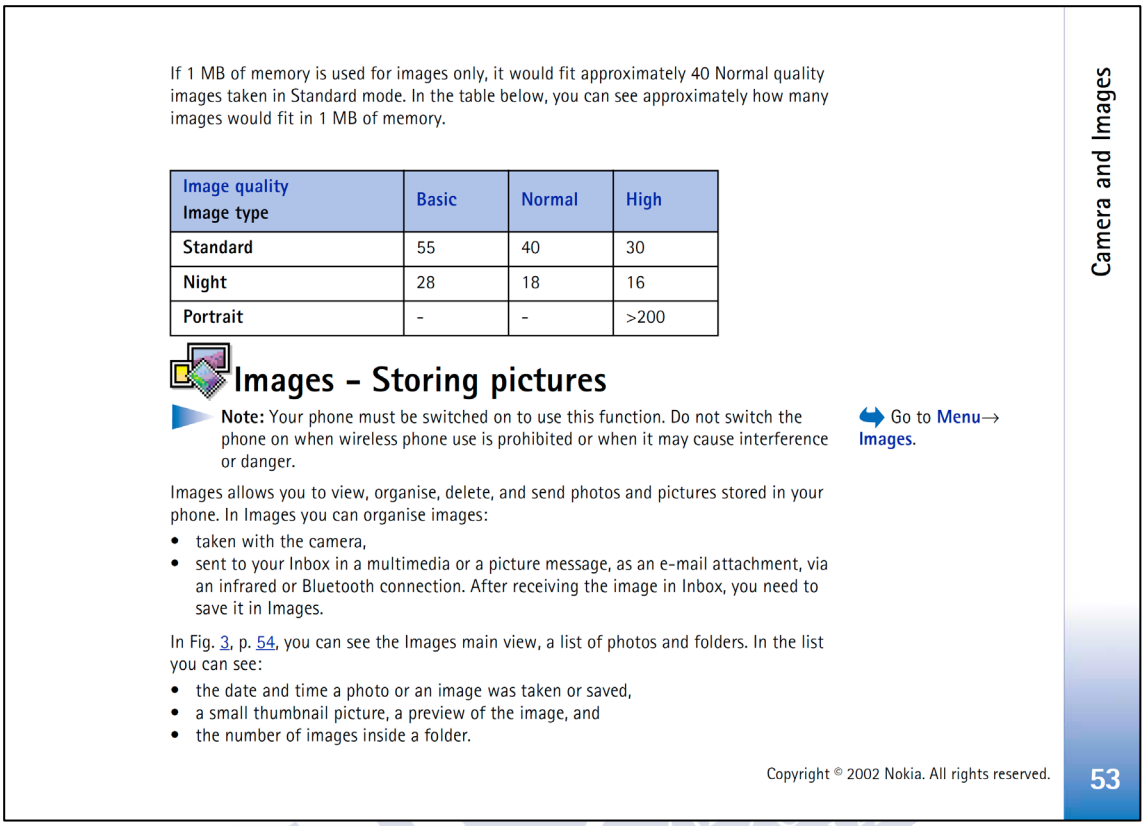
The scale in the production of mobile phones allowed to development of complex components under meagre cost. Accelerometers, gyroscopes, proximity sensors, touch screens and camera, have become cheap and advanced sensors, allowing other industries to use them outside their original mobile use. An example of this has been the use of those sensors by the television industry to create an advanced virtual and augmented reality for live events. (Méndez, Flores, Castelló-Mayo, & Viqueira, 2017; Méndez, Flores, Castelló-Mayo, Arenas, & Villaroya, 2015; Mendez, Flores, Castelló-Mayo, & Arens, 2016)

Even though mobile phones did not have a camera since the beginning, the relationship between smartphones and mobile photography is native. Some of the first phones with cameras could not be considered smartphones. Although they could take photos, there where little to no possibilities to do anything with them rather than look them in the phone. SONY ERICSSON T68i had the camera as an external complement, the MCA-20, that users needed to plug in to take pictures, and it was the first mobile phone to allow users to send images via MMS (Multimedia Messaging Service) (Ericsson,

Figure 2: Nokia 9210 is the first smartphone reaching the market, and Nokia 7650 the first smartphone whit an integrated camera. (© Nokia Oy, Nokia official press images)

2002). More models including cameras followed over the next years until the point that nearly all featured phones include one today.

At this point, we believe it is essential to understand what the main differences between smartphones and regular mobile phones, also called featured phones, are. Oxford Dictionary defines the smartphone as "a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, Internet access, and an operating system capable of running downloaded apps." It is the ability to install apps or another kind of software what mainly defined smartphones. The mobile device that is widely considered as the first smartphone is the IBM Simon Personal Computer (Aamoth, 2014). Despite the fact that it had some applications, those were preinstalled and did not allow the user to install new ones. The main change arrives with the implementations of SYMBIAN OS: A new operative system specifically developed for mobile devices which allowed the installation of third-party software. It was promoted by the SYMBIAN Ltd consortium created by the leading phone manufacturers such us as NOKIA, Samsung, Motorola and SONY ERICSSON. NOKIA 9210 Communicator, introduced in November



If 1 MB of memory is used for images only, it would fit approximately 40 Normal quality images taken in Standard mode. In the table below, you can see approximately how many images would fit in 1 MB of memory.

Image quality Image type	Basic	Normal	High
Standard	55	40	30
Night	28	18	16
Portrait	-	-	>200

Images – Storing pictures

Note: Your phone must be switched on to use this function. Do not switch the phone on when wireless phone use is prohibited or when it may cause interference or danger.

Go to Menu→ Images.

Images allows you to view, organise, delete, and send photos and pictures stored in your phone. In Images you can organise images:

- taken with the camera,
- sent to your Inbox in a multimedia or a picture message, as an e-mail attachment, via an infrared or Bluetooth connection. After receiving the image in Inbox, you need to save it in Images.

In Fig. 3, p. 54, you can see the Images main view, a list of photos and folders. In the list you can see:

- the date and time a photo or an image was taken or saved,
- a small thumbnail picture, a preview of the image, and
- the number of images inside a folder.

Figure 3: Nokia 7650 manual page. (© Nokia Oy)

2000, was the first to use SYMBIAN OS and therefore should be considered the first smartphone. It was one year later, in November 2001, when NOKIA announced the NOKIA 7650, the first smartphone with a built-in camera. Running SYMBIAN OS and with a VGA resolution camera of only 176x208 pixels, it was also the first NOKIA device that supported MMS. Apart from these, Nokia 9210 was the first smartphone to reach the market and Nokia 7650 the first one with an integrated camera. Both devices, shown in Figure 2, marked the start of what current smartphones are.

Since mobile phones have included built-in cameras, different systems have been used to manage them. The NOKIA 7650 already had to manage two image sources. Its user's manual explained in a very clear way that images could come from photos taken with the camera or the images received through MMS, as we can see in Figure 3. Thenceforth, smartphones had to face an increasingly complex scenario, with situations

that have increased the risk of losing data (Bushey, 2013). A study made by McAfee in 2012 showed that 5% of company phones got lost every year (Siciliano, 2012) showing that phones were not a safe place for a long-term storage of information.

Bigger and cheaper memory cards, better and cheaper cloud services, and, in many cases, apps that automatically upload user photos to a secure cloud, discourage users from deleting their images, increasing photo collections with pictures that in many cases lack quality or value (Sarvas & Frohlich, 2011). In previous studies, half of the adult users of digital photos did not delete any unwanted photo (Ofcom, 2015). At the same time, users take more than one shoot of the same object, people or situation they want to photograph (Kirk, Sellen, Rother, & Wood, 2006), multiplying the number of photos. Photos are shot all the time everywhere, and while there is an evident increase in the number of photos taken, this does not mean there is a growing increase in photography, as a cultural object of itself (Marzal & Soler, 2011).

Reports also show how cloud services are becoming a common place to store user images. Partly because of the simplification of automatic backups, as most of the smartphone users have a backup system if they have Wi-Fi connexion. However, there is also a growing perception between users on the importance of having their personal data protected with backups. Ofcom reports on cloud use show how 74% of users are already trusting clouds services to have their personal pictures on some online backup services or cloud. This same study also points out how the security of those images is the main reason to keep them in the cloud. However, the existence of cloud services and online backup keeps the standard digital photo user far away from having their images safe. We must keep in mind that nearly all smartphone users are digital photo users, even if they do not take pictures with their phones. As the same study showed, only one-third of digital photo users have backups of their photos (Ofcom, 2015). Without the right tools to manage mobile phone pictures, and a safe place to store them, not only are the memories of millions of smartphone users at risk, but also the valuable image documentation of how society lives in this period of history.

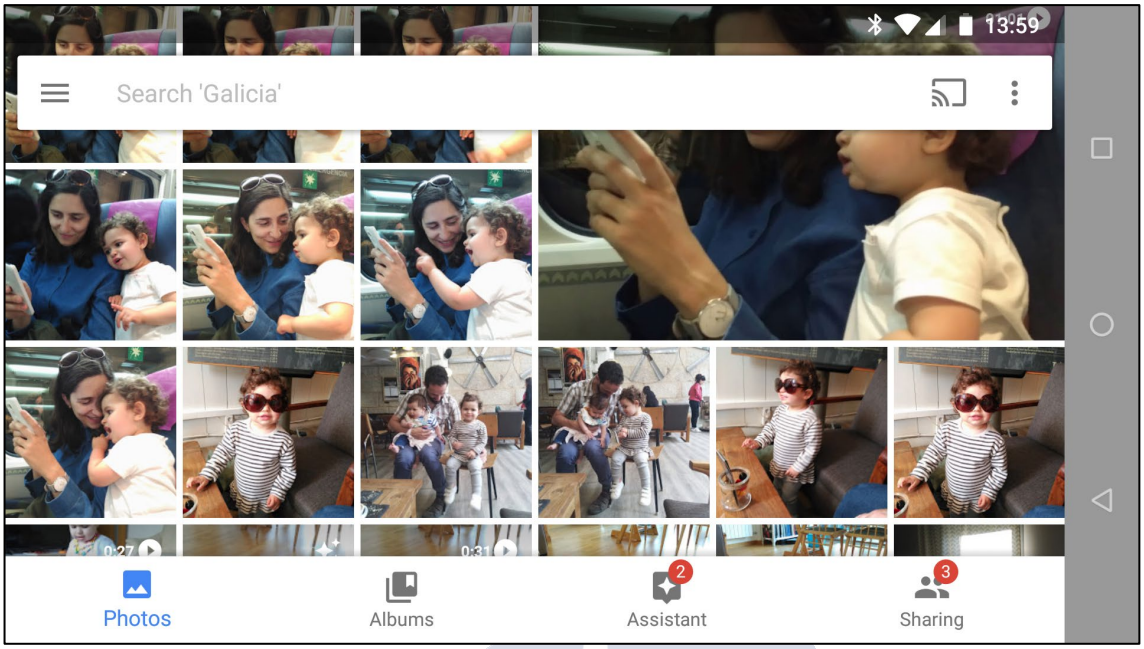


Figure 4: Google Photos (3.26) on Android OS. (CC Andrés Fraga. Screenshot of the software installed on an Android phone in landscaper view)

> There is a growing desire to salvage images produced in ordinary and everyday circumstances by ordinary people. Snapshots, and other amateur images, also frequently appear in news stories and can be found for sale at second-hand antique and retro markets. Images and perspectives previously denied space in the archive are now readily incorporated into its spaces and the normalizing archival perspective that Sekula confronts in his work is now fractured (Cross & Peck, 2010)

Bearing this in mind, it seems convenient that any future photo management solution should be able to work efficiently only with a mobile device, and more specifically with a smartphone, as tablets' penetration in the market is minimal compared to smartphones (Gartnet, 2015). That means that all the software developed during the first decade of domestic digital photography should be reviewed and adapted to mobile infrastructure. Computer softwares such as ACDSee, iPhoto or Picasa were fundamentally based on the fact that images were stored on a personal computer or an external hard drive and were designed to work with a user experience (UX) based on mouse and keyboard. The shift

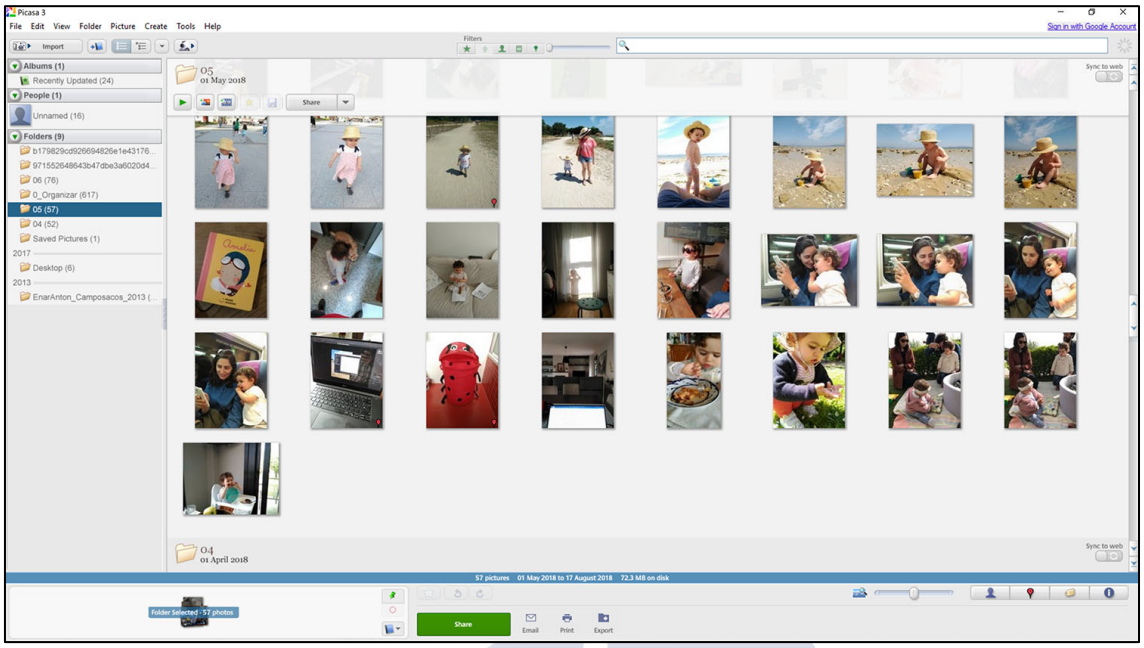


Figure 5: Picasa 3 interface in a Windows PC. (CC Andrés Fraga. Screenshot of the software installed on a PC)

to a mobile device infrastructure, changes the user experience design (UXD) radically, as we can see comparing Figure 5 and Figure 4. Limited by the size of the screen and the touch controls, interfaces became more straightforward, and process and actions must be performed in a much simpler way. Besides, following Sarvas definition of infrastructure (2011), the smartphone does not only replace the mouse and keyboard for a touchscreen but it also changes the concept of storage and archiving. The new reality is that, for most users, the smartphone has become the only infrastructure for photography. Smartphones are not only the tool to take photos but also the tool to watch, share, edit and store users' photo collections.

However, the approach to adapt the photo management tools from a pc to a smartphone is not limited to how to interact with the software or where to store the images. Smartphones have also changed the way users take pictures and the information they have about them. On the one hand, studies have shown how users make photos in many different situations other than before, backing somehow the previous “event” based organisation system that was central on photo management software for pc (Broekhuijsen, van den Hoven, & Markopoulos, 2017). However, at the same time, smartphones provide

images with much more information from a wide variety of sources. This information opens the door to provide intelligence to the process of organising and tagging personal photos, which has been one of the main problems of personal photo management in the ages of digital cameras and PCs (Kirk et al, 2006; Rodden & Kenneth, 2003).

Another challenge that photo management systems face in smartphones is the fact that the primary use of snapshot pictures has changed rapidly with the arrival of social networks and instant messaging apps. Services like WhatsApp that are used to send and receive images between smartphones have become very popular. In the case of WHATSAPP, with more than 1 billion people using the app in 2019 (WhatsApp, 2019), it has a market penetration of more than 80% in countries like Netherlands, Spain or Italy. The increase in the numbers of users of instant messaging apps creates a significant number of new images that were not taken by the owner, and that must be managed from the smartphone directly.

The different solutions that present the photo management apps offer are based on twenty years of digital photo management software for consumers. Current services, both apps and cloud web services, have been able to solve part of the mistakes that their desktop predecessors have made. It is also essential to consider that, right now, the different solutions in mobile photo management are not only limited to the software that can be installed in a smartphone or a tablet. Cloud services, social networks, apps and operating systems (OS) are trying different ways to attract the users' attention to let them manage their images. Apart from this, in some cases, they have unified all the previous systems in one unique system. At the same time, hardware specifications are less limiting, as most of the systems are available through many different devices. In most of the cases, those images are available independently from where the user is connected and what the hardware is. Therefore, the solutions should be more creative than in the times of physical albums or digital cameras and should be more focus on the user's experience. It must use some of the available technologies together, so the user can have the experience of watching a family album again, even though the way he is doing is different.

The contribution of this work is to understand to what extent the shift from traditional family albums to digital photography on smartphones can keep the role of photography in shaping individual and collective memory and it proposes ways to improve this in the future

> Not outstanding design, better design... we can improve some things, but it is not spectacular. To improve a television or a computer, to make it more self-explanatory, to make it more usable, it is always a very important thing, but it is not a spectacular thing (Rams, 2009).

1.2. JUSTIFICATION OF THE STUDY

In August 2016, GOOGLE published a short advertisement about their GOOGLE PHOTOS service, introduced the previous year. The video recreated the footage before capturing a photo with a smartphone. Just when the best moment for a photo was about to be, the phone shows a message that says "Storage Full, there is no more room on your phone" in a design that clearly copies the iOS interface (Figure 6). Finally, the video presented a feature that allowed users to delete the images that where safely store in GOOGLE'S cloud (Google, 2016). The advert have been targeted to iPhone users, especially with those with only 16GB of space, who often suffered from lack of space to storage their images (Welch, 2016). However, it is based on a much more complex problematic, that is the difficulty of photo management in smartphones.

In my personal experience, being a professional photographer and photo editor for the last 15 years, I have learned to manage extensive and complex collections of photos. I have done it with my own professional archive and with newspapers and digital magazines. Nevertheless, I have not managed to organise my personal collection, especially the ones I take using my smartphone. This personal problem has been the trigger to start this research.

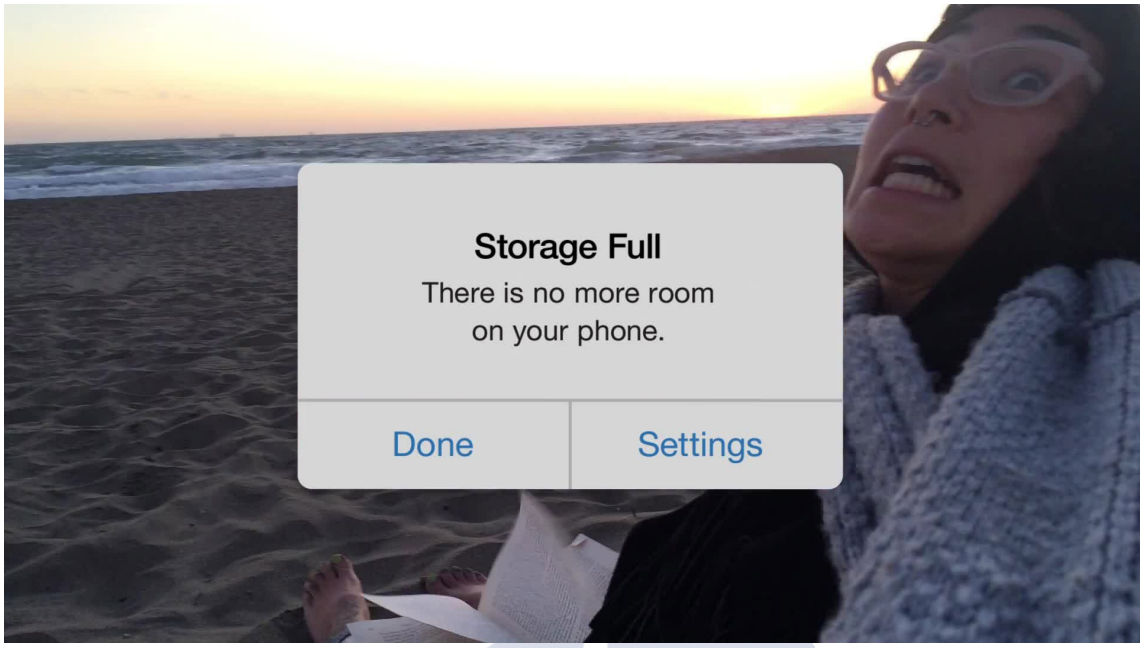


Figure 6: Frame of a Google Photos advert published by Google Australia in their Youtube Channel. (© Google)

1.2.1. The disappearance of the traditional album

In less than 200 years of history, photography has managed to have a crucial role in people's daily life. Photography is present in a vast number of fields, from marketing and entertainment to engineering or research, and in all those fields, its importance has been consolidated. However, if we concentrate on the numbers, domestic photography is the sector with a highest volume of users and growth (Sarvas, 2014).

The KODAK business model had created a solid base of users, covering most of the first world families in the 90's (Tsurumi & Tsurumi, 1999). At that point, the arrival of digital photography changed dramatically the way domestic photography was organised, from industry to consumer habits. This change caused an increasing interest from the academic world, both from universities and private research institutions, that tried to understand the new situation and provide solutions to the users. During the first decade of the 21st century, many of these investigations created a subsoil for popular services and software to organise home photo collections. The previous system, mainly the photo album but also spare pictures stored in boxes, the so-called “shoebox” and the “rogues

galleries" (Frohlich & Drazin, 2007), or collages of photos on walls and fridge doors, had more than a century of existence and has proved to be very useful in its role as a tool for memory, identity and communication (Chalfen, 1987). Despite the interest in finding a tool that could fulfil the needs that the missing physic album served, most of the users experiment frustration while trying to visualise their images in the long-term (Miller & Edwards, 2007; Whittaker, Bergman, & Clough, 2009).

Domestic or personal photography could be seen as useless information out of the domestic space. It is not a work of art or a famous monument that must be studied as an individual piece or preserved for future generations as a unique and specific value. But this approach to domestic photography has changed over the last decades, and their value as a sociological tool is more widely recognised. As Susan Sontag describes in his book *On Photography*:

> A photograph of 1900 that was affecting then because of its subject would, today, be more likely to move us because it is a photograph taken in 1900. The particular qualities and intentions of photographs tend to be swallowed up in the generalized pathos of time past. Aesthetic distance seems built into the very experience of looking at photographs, if not right away, then certainly with the passage of time. Time eventually positions most photographs, even the most amateurish, at the level of art (Sontag, 1973).

This value, gained over the time, is more visible with pictures taken in times were photographs were more scarcer, and therefore, it was recognised more easily (MacDonal, 2015). However, the value of those images is not related to a single image as it is their general significance for visual communication (Van Dijck, 2008). It is not about how worthy a photo is or can potentially be, it is about the value that millions of images, their uses and their role in the contemporary society that gives value to domestic photography.

The importance of studying snapshot photography comes supported by the fact that it is one of the most common types of photography, and most people in the western world have seen or create an album, at least during the XX century. However, the study of

snapshot photography should be focused on what a single photograph *is*, but on what a photograph *does* (Sandbye, 2014).

1.2.2. Mobile changes everything

The emergence of smartphones, with a camera as one of its essential characteristics, has implicated radical changes to snapshot photography. In 2014 there were 2 billion estimated smartphone users and 4 billion people are expected to have a smartphone in 2020 (Evans, 2015). That means that in a few years, half of the population on the planet will have a camera and that camera will be connected to the Internet. This growth in the number of cameras in the market, together with the ease to use in most of the camera phones, imply a growth in the number of photos taken. It is impossible to calculate that number with precision, but if we consider that the approximate number of pictures shared on social networks in 2014 was 800 billion, that implies ten times more pictures than all the film pictures taken in 1999 (Evans, 2015). We can assume that the number has increased dramatically. It is also vital to notice that this growth has been specifically concentrated on personal use.

However, it is not only about the new user. Photo management habits have also changed with smartphones. The previous cycle of PhotoWork, shown in Figure 7 (Kirk et al, 2006) involves capturing a photo with a digital camera, download it to a computer, file the images, edit them and finally share them finally. Nevertheless, current photo live cycles are now taking part in the same place, unifying, in the majority of the cases, all the previous infrastructure needed for digital snapshot photography in one unique device.

Smartphones, as the unique unifying infrastructure for snapshots photography, must fulfil all the needs that were previously met in many different devices, that were designed for every specific steps of the process, with the additional limitations that a mobile battery-powered small device has.

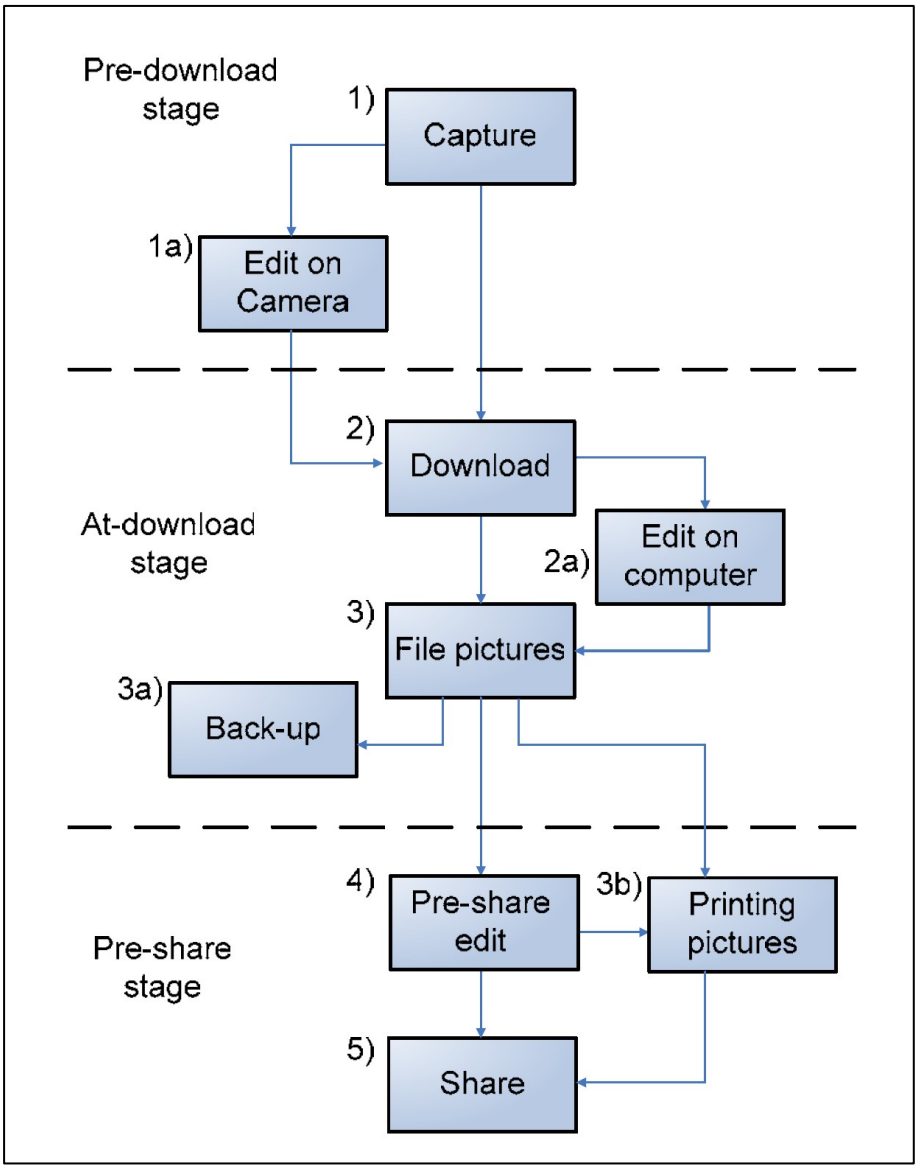


Figure 7: Cycle of PhotoWork. (Reproduce from Figure 2 in (Kirk et al 2006). Original title: Flow diagram of PhotoWork lifecycle.)

Far from helping to solve the problem with long-term retrieval of personal photos, this change caused that the previous solution, designed to work with digital cameras and personal computers, were no longer valid for a smartphone-centric reality. At the same time, social networks and photo sharing monopolised all the attention of app developers, manufacturers and operating systems, drawing the attention of researchers in that same direction.

During the last ten years, the image quality of smartphone cameras has improved dramatically, becoming a reliable alternative to compact cameras for most domestic users. At the same time, the apps market got full of photo editing apps that allowed users to retouch, edit and compose their photos in a much simpler way than with PCs. All social networks adapt their interfaces to work with mobile phones and develop proprietary apps to facilitate the use of their channels as tools to share images. The growth of mobile instant messaging apps like WHATSAPP, VINE or LINE embody the use of photos in their ordinary usage, until the point that specific photo sharing apps like SNAPCHAT or INSTAGRAM have reached the top shares on the market. All this activity on the smartphone is constructed around the idea of sharing but pays little or no attention to the life of pictures after that moment.

Notwithstanding, users still have an interest in their images as studies have shown (Ofcom, 2015), and they need to have tools that help them to give the deserved value to those images. They need tools that provide the user with the possibility of curate their personal images. Tools that, in the end, make possible that snapshot photography can work as pieces of memory construction, identity and communication (Chalfen, 1987). Tools from the 21st century that fulfil the role of the traditional album but have been adapted to the new requirements and rules of mobile UX, ubiquity, multiplatform, cloud, and AI. Also, they should fit in this new smartphone context smoothly enough for the user to use them. Those tools, those systems, must provide the users with a better experience and usefulness that old albums and shoeboxes, or at least, the same.

Finally, it is essential to emphasise that current photo management systems in smartphones will be the primary tool for users to interact with their photo collections. That will create new habits in photo consumption, as described by Elizabeth Shove: “domestic consumption and practice are intimately linked in reproducing what people take to be normal and, for them, ordinary ways of life.” (Shove, 2003). All agents involved in shaping the tools for mobile photo management, software developers, smartphone manufacturers, mobile carriers as well as legislators and academics, have now a crucial role in shaping the way current and future generations will interact with a crucial part of their memory, identity and communication.

1.3. OBJECTIVE OF THE THESIS

The primary objective of this thesis is to provide a set of essential characteristics that future systems of photo management on mobile devices should have to fulfil the user's needs. We refer to photo management systems as the features of operating systems, apps and online services that are designed to manage and organise pictures stored on the phone or coming from phones. We are aware that media consumption and creation in smartphones has images as well as videos, but we have focused our research exclusively on still images. Although there is also a long tradition of family movies, the support and management of analogue movies and analogue photos were very different. Our research is focused on detecting how to meet the needs of traditional photo albums in the current smartphone ecosystem.

This objective takes us to work on a series of research questions around mobile photo management. The main one is if the current photo management solution for digital images fulfils the role that traditional photo album had on western society. To answer this question, we have mainly focused on the smartphone, as the most common snapshot camera nowadays. This question, of course, takes us to further questions, like what was the role of the traditional photo album, what is the current use people have for photography on their smartphones, and what are the alternatives to traditional photo albums. Concerning the smartphone, what are the current solutions and technologies that offer the user tools to manage their photo collections on their smartphones and tablets.

Part of this objective is to prove that current systems are not fulfilling the needs of the user concerning the long-term management of their personal photo collections. To do so, we intend to update the research conducted in the first decade of the current century on digital cameras and personal photo management with digital images in the computer. We will explore the same questions and research questions of those previous studies but this time in the context of mobile devices, especially in smartphones.

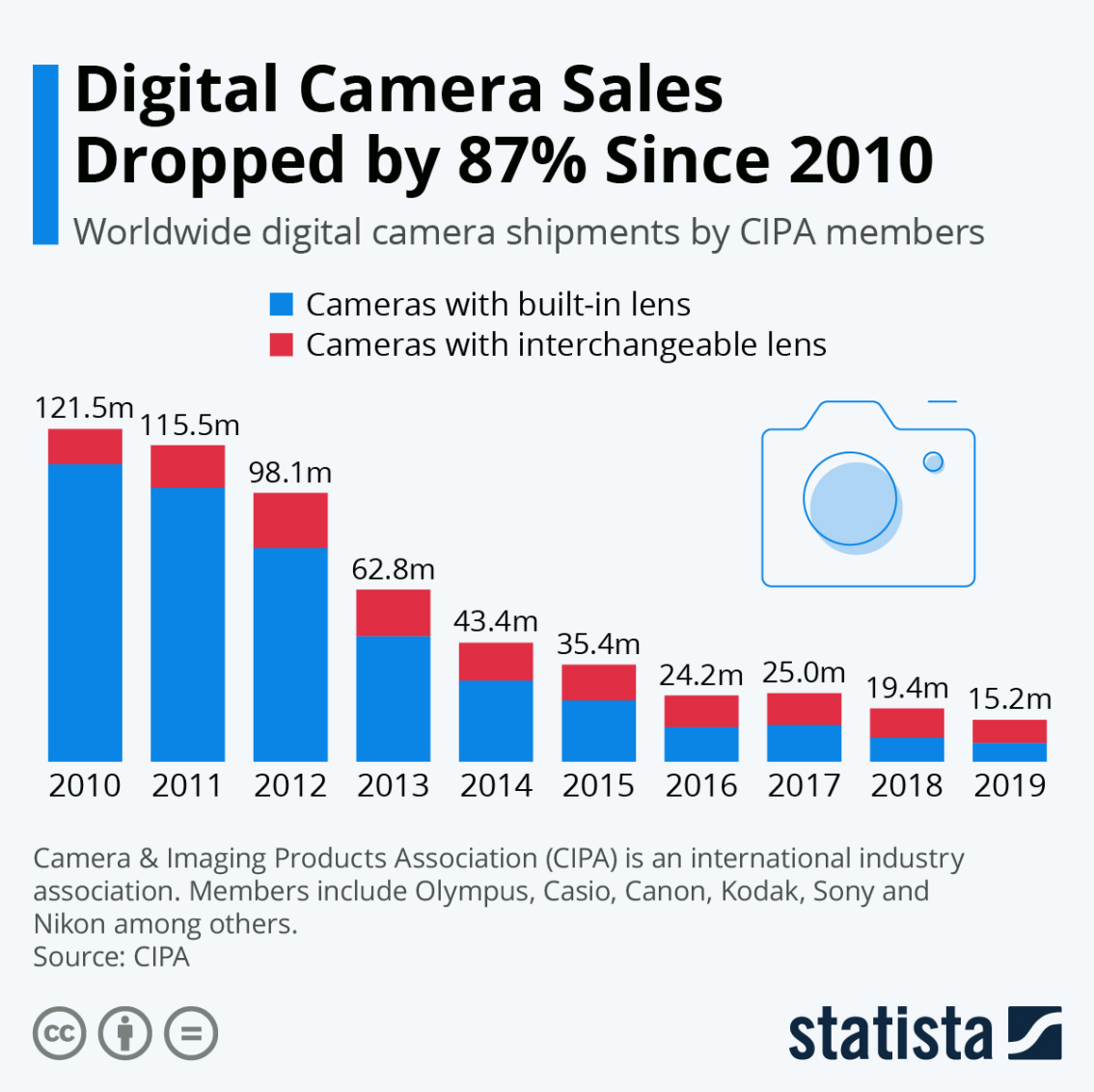


Figure 8: Drop in camera sales in the last decade. (Table by Statista with CIPA report as source)

Another objective of this research is to open a line of research that will summarize previous work made in the first decade of the current century but updating the context from digital cameras to mobile phones. In the last decade, most of the research focused on photo management and HCI (Human-Computer Interaction) has mainly concentrated on sharing and social networks. We aim to call some of the attention back to the long-term approach to this area of research. It is also the aim of this research to draw some guidelines that could help future designs to solve current problems of personal photo

management. We are also questioning how those technologies should be applied and what should be the objectives that should be prevalent in the design of solutions.

We believe that an approach to this field that is exclusively technological or exclusively sociological does not provide with enough solutions. We assume that a more multidisciplinary approach to personal photo management is needed in order to create tools that can solve current, and future, needs in snapshot photo management for smartphones.

1.3.1. Scope of research

In this research, we have focused on the field of snapshot photography made with mobile phones and more specific with smartphones. Although we know that snapshots are also made with digital consumer cameras, we decided to limit our research to mobile phones, and specifically to smartphones, using the leading mobile operating systems: ANDROID, IOS and WINDOWS 10 Mobile. Comparing the growth in the mobile phone market (International Data Corporation (IDC), 2015) and the decline in the sales of cameras (CIPA, 2015), shown in Figure 8 , we decided to focus on smartphones as they represent the most used camera in the daily life.

We are not concentrating on the amateur photographer or user with an interest in photography as a hobby or semi-professional use. We want to study the uses and environment of the domestic user, for whom photography is not a primary interest, but a tool to represent his domestic life (Sarvas & Frohlich, 2011).

1.3.2. Hypotheses

- Current photo management solutions for mobile devices are not working as long-term tools to memory. Smartphones have become the primary consumer camera and at the same time, the central device for media consumption, so smartphones must handle personal photos from the

creation to the final use as well as allow future retrieval. We believe that the existing solutions, both in operating systems and apps, are not considering the long-term factor in the way traditional albums used to do.

- The increasing number of photographs on user smartphones makes the curation process of separating the relevant images among the current stream of images hold in smartphones challenging.

- Systems are not providing users with the right tools for an easy curating process. Systems are not considering the typology, source and authorship of the different images users have in their devices to facilitate their curation process.

- Systems are not using standardised metadata to enrich the photos with context. Smartphones are great tools creating contextual information around a photo, by adding information about the time and place the image was taken.

- Intelligent image processing is adding more information about the objects and people in the images, creating a context around every image or image collection. However, this information is not being attached to the photo file in a readable form to be used by other systems and services.

1.4. STRUCTURE OF THE RESEARCH: A THREE-STEP APPROACH

One of the first things that we notice in the first months of this research was the lack of academic data that could allow us to state that my personal problem with smartphone photo management was actually a common problem. There was a general feeling of lack of control concerning personal photos taken with smartphone. We could perceive that

when talking with friends and family, or even with other professional photographers, but we could not find any academic study that could offer us solid data to base our hypothesis. For that reason, we decided to focus the first part of our research on obtaining that information so we could have solid and updated background to stablish our hypothesis. At the same time, we were receiving the point of view that users have over the problematic of smartphone photo management. The conclusions obtained from this part of the research created the ground floor of this thesis. All the research conducted around the user's point of view is organised in Chapter 2 of this thesis, and most of the content has been published in adComunica nº13 in January 2017 (Fraga & Forti Buratti, 2017).

Once we have reliable and updated data of the user's habits in smartphone photo management, we decided to turn our view to the different solutions that they currently have in their smartphones. We decided to analyse how apps and OS manage the photographic content of smartphones. With this data we can compare the user's problems with the solutions that the industry is currently offering. In this way we could have a different point of view for the same problem and find gaps that are not being covered by current systems. In order to obtain more accurate data on a field that is in a constant and fast change, we decided to extend this part of research to a longer period of time. All the research performed around systems for photo management is organised in Chapter 3.

Finally, in order to increase the reliability of the results, we decided to create a panel of experts that could express their opinions in the conclusions obtained in Chapter 2 and 3. The use of these panel groups aimed to add more points of view over the studied topic, as the experts came from different backgrounds. At the same time, their proved experience could contribute with a more long-term view. We believe this is especially valuable in a field that is changing so fast. It is after the results of the conversations with our expert panel that we discuss all the data collected during the research. All this information is organised in Chapter 4.

1.5. THEORETICAL FRAMEWORK

Management of personal photo collections is a new area of research emerging from the recent developments both in the technology industry and human behaviour with this technological change. It is probably Richard Chalfen's (1987) book, *Snapshot versions of Life*, the one that lays the foundations of this field. In Chalfen's book, domestic photography is probably living the most stable moment in history. Except for Polaroid instant film, the KODAK culture has existed for one hundred years, with slightly small changes. In domestic photo management, the family album and the shoebox were an absolute standard in the western culture at that time. Most of the research was focused on analysing the role of the family album in society and its role in memory, communication and identity. From the industry point of view, little modifications have been made to the albums as a physical product, and likely the main change was to substitute the cuts of paper corners with a film of plastic as a method to hold the paper images.

It is a few years later, with the arrival of digital photography to the domestic world, that the academics started to point their attention on what has happened to the traditional photo album and what is changing in the digital photo ecosystem flow (Neustaedter & Fedorovskaya, 2009). During the first decade of the 21st century, there is an increasing interest both from the academics and the industry. New teams and researchers are interested in HCI social psychology research and industrial design. For example, Steve Whittaker, David S. Kirk, David Frohlich, Abigail Sellen, Steve Whittaker or Willian Odom point their attention on how the conversion of photography in the digital world could be done in the domestic field. Research also started to pay attention to how this formal change in photography could change the habits and therefore, the influence of photography in the domestic sphere. On the other hand, the industry was searching for a valid and reliable way to meet this new need of digital photographers, so many of these researchs were supported or developed by the research centres or labs from companies such as HP or Microsoft.

Figure 9: A Kodak advertisement from early Kodak cameras .(Unknown artist. New Kodak Cameras. "You press the button, we do the rest.", 1890. Wayne P. Ellis Collection of Kodakiana, 1886 –1989 and undated, Emergence of Advertising in America, 1850 –1920, Duke University)

1.5.1. Snapshots, albums and shoe boxes

Photography, understood as technology to captures images, is present in many fields and disciplines. It can be used in medicine or astronomy research, with common aspects but enormous differences in the way it is applied and studied. Therefore, a narrow definition of what we understand as photography in this work is needed and that would be snapshot photography. Snapshot photography is the term that most commonly defines the kind of photography we have studied in our research. It is the most common kind of photography we find on our mobile devices and the one that used to fill our family albums. Snapshot, as a photographic form, emerges when the technology to automatically reproduce the reality, free from manipulation, is accessible (Prieto, 2010), or in words of Asko Lehmuskallio, a familiar and formulaic activity (Lehmuskallio, 2015). When in 1888 Eastman released the KODAK camera (Eastman Kodak Company, 2019) he used the famous claim "You press the button, we do the rest" (Figure 9). This new type of camera, and the business model resulting therefrom of it, allowed families to document their social and personal events. The easiness of use of this first snapshot camera was their main claim and opened up the door to a whole new range of users. These snapshot photos were free from the artistic pretensions of posed photos of professional photographers (Miller &

Edwards, 2007) and started to document a whole new side of society that had been never photographed before.

Although the term snapshot is widely used to refer to amateur photography made at home (Ford & Steinorth, 1988), other terms like family photography and domestic photography are also common. Sarvas and Frohlich (2011) define domestic photography like the one that rests at home, but they also point out how not only snapshot photography is included here, as the family collection also includes, in many occasions, portraits or wedding photography made by professional photographers. One example can be seen in Figure 10, where two images taken by the owner of the album, in a typical combination of pets and children (Chalfen, 1987), share space with a portrait made by a professionals photographer at the studio. In that case, a complement from a postal relation from children, used to learn and improve their skills in other languages.

It is also essential to differentiate it from serious amateur photography, as this is done by someone with interest in the photography itself, as a hobby. Sarvas pointed this out when he tried to distinguish and delimit the uses and description of *domestic photography* and *family photography*.

> We use the term domestic photography to describe the photographic activities of ordinary people taking and using images for non-professional purposes. Also, in our use of the term we focus on the kind of use in which photography is not a hobby as such but embedded in other activities (Sarvas & Frohlich, 2011)

José Van Dijck, on his *article Digital photography: communication, identity, memory* (Van Dijck, 2008) also states in a note the importance of differentiating between professional and non-professional photography, but he tries to avoid the use of the term *family photography* or *amateur photography* in favour of the term personal photography. He defends that the qualifier *personal* also works to differentiate it from the professional use of photography but avoids the troubling connotation of 'amateurish' concerning camera use. Van Dijck also defends the use of personal compared to family as the term "Family photography mistakenly presupposes the presence of a familial context" while

Figure 10: Page of a family photo album where snapshots and professional photo studio images coexist. (CC Andrés Fraga)

photography has been used as a tool for personal identity formation (Lury, 1998; Wells, 2015)

Despite the casual look of snapshot photography, images are made with deliberate control over what, who and how are the pictures (Chalfen, 1987). Moreover, these decisions were made under the recommendation of KODAK ads campaigns, which show

the user when and where they should take their photos (Lehmuskallio, 2015). Richard Chalfen named this shape of users' habits made by KODAK as “Kodak Culture”. It is after Chalfen's work in “Snapshot Versions of life” that most of the research has been done under the premise that the values of domestic photography are to support memory, communication and identity. However, with the rise of digital photography, those roles, or to be more precise, the importance that each of these roles have, started to change. Work made by Van Dijck (Van Dijck, 2008) goes more in-depth into these new values. The rise of social networks has also helped to change users' interest, shifting from being focused on memory preservation to be more about communication and identity (MacDonald, 2015).

Anthropological studies such as Elizabeth Edwards's work *Photographs and the Sound of History* (Edwards, 2005) points at family photography as an interactive medium, as it creates history and unlocks memories originating a feeling that otherwise would not have been articulated. This view shows that the potential of snapshots photography goes beyond being memory storage, as they are a tool to create and archive family history (Chalfen, 1987; Petrelli, Whittaker, & Brockmeier, 2008; Stevens, Abowd, Truong, & Vollmer, 2003)

Despite shoeboxes, those paperboard boxes with photos with none or small organisation, have also been a place to storage domestic photography, the main space to organise personal photo collections has been the photo album (Drucker, Wong, Roseway, Glenner, & De Mar, 2004). Those photo albums and boxes have been part of the domestic landscape of western households for the last three generations (Coleman, 1998; Van Dijck, 2008). Although there are also many different attitudes towards photo albums within countries, (Prieto, 2010) they became a crucial piece for the concept of family (Sontag, 1973). As Marianne Hirsch describes, photographs create an “umbilical” connection between first -and second- generation remembrances, memory and postmemory (Hirsch, 2012). And that goes beyond the quality of the images, as the different roles of domestic photos are over the concept of quality (Ortiz García, 2006).

However, every album, or every collection of albums, has a beginning point, and in most cases, it has a direct relationship with the beginning of a new life in the family (Chalfen, 1987). Sometimes, wedding pictures, even though they are not snapshots, are the starting point of the newly formed family photo collection. Wedding pictures have become so vital that they have turned into a part of the ceremony itself (Sontag, 1973). New wives or new mothers are the ones who traditionally have supported the central role of photo curation, in both albums and photos displayed at home (Durrant, Frohlich, Sellen, & Lyons, 2009) and are still doing it today in social networks (Le Moignan, Lawson, Rowland, Mahoney, & Briggs, 2017). This curation process implies both the selection of the "chosen" images as well as their arrangement in the album (Kelm, 2016). This process was needed in the traditional photo albums as it is still needed with the arrival of digital photography (Van House & Chulchill, 2008).

We are not only interested in photo albums as a process or a methodology to manage photography. We are also not approaching it as a physical object to study. Traditional photo albums had a role in western society and academics have widely studied this. From the "*aide de memorie*" mentioned by Chalfen to the shapers of household memories described by Sellen (Banks, Duffield, Sellen, & Taylor, 2012). Sarvas (2014) describes it as one of the most critical ways of constructing togetherness, shaping one's identity, and documenting events. In fact, the role of photo albums is not only based on their images, as the contextual information is subtly organised in short annotations and date, but mainly, as oral communication. Many authors have studied the importance of oral communication as a tool to provide the context needed to fully understand the images of an album (Chambers, 2001). This dependence on oral communication makes long-term future remembering very depending on this oral communication to work fluidly between generations. Karen Cross and Julia Peck even stated that photographs are "empty shells they may be subject to fruitful analysis as our responses to them are both voluntary and involuntary." (Cross & Peck, 2010)

Although memory and remembering was the primary function of traditional photo albums, communication and identity were also roles of snapshot photos (Chalfen, 1987). Nowadays, the images can be found in walls, fridges, desks and smartphone wallpapers

(Kim & Zimmerman, 2006; Sarvas & Frohlich, 2011). These different locations within home limits work as privacy containers, making it pretty simple to decide which part of the family photo archive is public and which is not, setting the level of access to each picture. A family group picture hanging in the wall at the entrance lobby and a photo in the bathroom where the owner poses in bikini have different public in mind and also differ on the level of privacy. While the former builds the public image of the family too, the latter reminds of the importance of keeping a healthy diet.

1.5.2. Digital reality in the domestic environment

The introduction of digital photography in the domestic world created profound changes in home mode imagery. The deep connexion between photography as consumer goods and the structure of capitalist production and consumption makes domestic photography a field tied to profound changes (Shove, 2003).

> "Silverstone (2007) recently argued that, while modernity has been defined by the increasing presence of technology, visual media technologies have been the most significant recently in becoming environmental and therefore central to the management of everyday life. By this he means that media technologies now provide the infrastructural framework for the ordering of communication and information production, consumption and exchange (Shove, 2003)

The whole photographic infrastructure defined by Sarvas (2011) changes from the KODAK business model to a set of new alternatives that, especially in the first years of digital photography, had no prevailing solutions. From using web services like FLICKR (MacDonald, 2015) to keep using physical photo albums printed in online services. During the years that took to conclude this research, we have seen many patents related with systems to print photo albums from apps or web services, meaning that physic photo album is still considered, at least from part of the industry, as a viable alternative. This behaviour is usual with any new technology that emerges, and it is essential to consider that Kodak Culture took almost half a century to be established.

As a result of digitalisation, domestic photo collections changed from a physical object to a collection of complex digital objects with a massive variety of associations, reinterpretations and uses (Bushey, 2013). Images are scattered to computers, external hard drives, cloud services, smartphones and social networks, with users quickly forgetting or misplacing the location and identity of photo collections (Frohlich, Wall, & Kiddle, 2012). This breakup of personal data leads to a paradox, described by Chen (2016), where the user could end up dedicating more time to organise their pictures than to enjoy them. This also affects the curation process, as digital technologies have undermined the traditional role of mothers as family photo curators. Besides, the role that members of the family had on the photo flow has also changed, as there is no more a single "family camera" and all the members of the family are photographers and curators of their own photo collection (Durrant et al, 2009)

However, digitalisation allows the curation process to get some benefits by automating some of the processes. Digital collections allowed to create straightforward ways of organising pictures by date, as the information about capture time was usually attached to the image. It is also effortless to download the images to a computer, format the memory card and keep taking pictures. This simplification delegates some of the responsibilities that users used to have in the Kodak culture to the infrastructure. This transfer of responsibility leads to some of the problems that users have managing digital collections of photos. Whittaker et al. point out how the automatization of that process could help to ensure that the necessary organisation is taken, despite the lack of time and dedication from the users. They emphasise that, for these technologies to be beneficial, users must be willing to use them (Whittaker, Bergman, & Clough, 2009). However, they also explained that users need to interact with their photo collections in order to have their collections organised. The fact that the photo management system tends to automate the process of album creation and tag annotations limit more the exposure that users have to their photo collections.

The automatization of the curation process also has other indirect consequences. Keywords, when generated by a computer, only have one interpretation. However, human interpretation is way more sophisticated. The importance that every image has is not a

constant that can be set; it depends not only on the content of the image but also on the moment the image is being watched and who is watching it. Chalfen (1987) already pointed that, in Kodak culture, an outsider of the family or social group that has some implication on the photo taken, does not have types of knowledge or information needed and expected to make appropriate home mode interpretations of what it is happening in the scene. This lack of contextual information will limit the effectivity of automatization of some of the curation process, as systems would easily also lack this knowledge and understanding. Current technologies like face recognition, big data processing techniques and sophisticated algorithms could help "teach" the systems about user context. It is not fanciful to think that a system correctly programmed to do so, feed with the correct information, could achieve some success in curating distinctive typologies of images. One example could be that the system could deduce that a baby that has started to appear with a high level of frequency on one user's images collection could be the son or daughter of this user. However, to fully understand the importance that those images can have in every user and every moment, there is still a long way to compete with the sophisticated understanding of the social environment that surrounds every image. It is in this field, in the accurate evaluation of image value, where machine learning and computer vision have still plenty of research to do to equal the human capacity to measure the value of an image.

1.5.3. Photo management and its adequacy to the digital home

Photo management software started to become popular when it was part of the operating system, such as in APPLE iPHOTO and WINDOWS PICTURE AND FAX VIEWER. Professional software for digital image management had already years of experience and software like APERTURE from APPLE and LIGHTROOM from ADOBE had created workflows and tools that allowed professional and amateur photographers to successfully manage significant amounts of images successfully. The use of standards such as IPTC, created by the International Press Telecommunications Council, allowed professionals to add contextual information to their images with the assurance that all the systems following this standard could read and edit this information

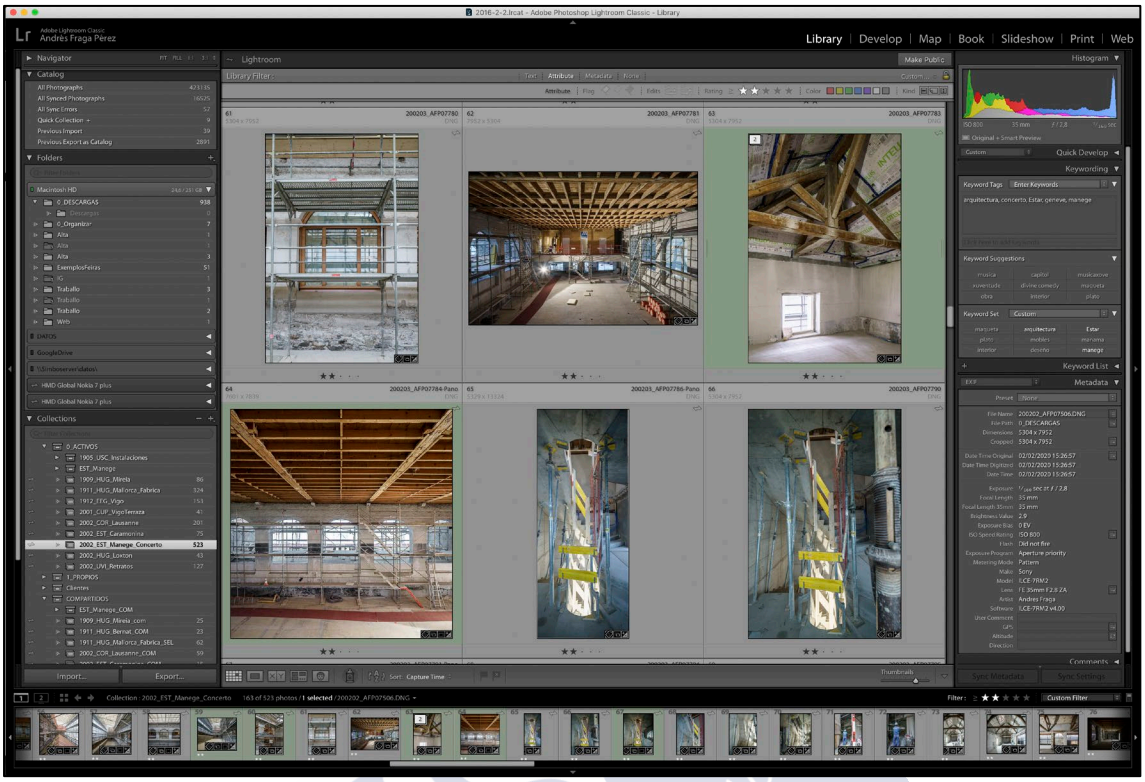


Figure 11: Lightroom is a professional software for photo editing and management. It offers a very complete set of tools, but the interface and use are more complex that average non-professional software. (CC Andrés Fraga. Screenshot of the software installed on a PC)

In the case of mobile phones, this software started to be part of the OS as soon as they started to include cameras. The first smartphones with a camera only had to deal with two sources, camera and Multimedia Messaging Service (MMS). Photo management started to be more complicated as soon as new sources started to be available, creating a scenario that has increased the risk of losing data (Bushey, 2013). This complex scenario is not only created by the fact that users have many different sources, but also because there are more photos of the same event or scene. Moreover, new uses have emerged with the appearance of new apps like WHATSAPP, creating new typologies of images that, in some cases, do not have the value that traditional domestic photos used to have.

Previous studies about the user's experience of managing a digital collection of photos made with consumer digital cameras show that it can create an important level of frustration (Whittaker et al, 2009). Even if users have a high level of motivation in the long-term retrieval of family pictures (Whittaker et al, 2009) there is a lack of confidence

Figure 12: Traditional album with handwrite annotation including references to dates, places and people on the image. (CC Andrés Fraga)

in online photo store solutions (Ofcom, 2015). Besides, we have seen in previous studies how users have been trusting the different cloud, and local solutions and this has created a fragmentation of digital possessions (Odom et al, 2013) and serious concerns about privacy (Miller & Edwards, 2007).

However, traditional photo albums are not only a collection of images. Annotations and oral tradition created the context needed to understand and give value to those photos (Chambers, 2003). This contextual information is, in many cases, part of the album itself, and it can be related to a group of images, creating a story that needs all the factors: the image, the text and the physical space that puts them together (Bushey, 2013). In the example shown in Figure 12, some annotations introduce information to help readers to understand the context of the images. Despite that, there is a lack of relevant information. Issues like where the photos were taken, who are all the people in the photos (as an

example, the baby in the photos has no name) is information that was either unnecessary in the family context or was explained orally in the moment of sharing.

With the arrival of digital photography, many companies have tried to include this context in the form of descriptions and tags or keywords or creating collections and albums. The fact that most of the users are reluctant to annotate text in their photos (Rodden & Kenneth, 2003) has resulted in the development of automatic systems to help organise and curate the increasing number of photos that users must deal with (Kirk et al, 2006). An excellent example of useful automatic tagging is face recognition, as most of the domestic photography includes people (Chalfen, 1987). The introduction of Machine Learning (ML) technologies has pushed the image recognition error rate as low as 7% (Evans, 2017). In addition, domestic photo collection usually repeats a relatively small group of faces of family and friends. This makes facial recognition a handy tool for automatic tagging. Location is also valuable information that is now integrated into most systems, as geolocation is very common in all smartphones, and it has shown to be an excellent tool to image retrieval (Chen, Oakes, & Tait, 2006).

Primary contextual information was present in film cameras from the late 70s in the form of date stamping. Some professional film cameras as the EOS-1 V even could export captured data such us apertures and exposition through specific software. However, it is with the arrival of digital photography that that attaching more contextual information to images in domestic use became possible. For this purpose, metadata standards have been used in digital photo management for years. Information such as time and date, location and camera characteristics have been attached to both digital cameras and smartphone images. The use of standard such EXIF has allowed building software and services that cannot only use but also preserve this information. Nevertheless, when dealing with information from content-based image analysis or other automatic process based on artificial intelligence (AI), systems face the central problem of the polysemous nature of images (Barthes, 1977), where the same person, object or situation might have different meaning and importance to different people (Chalfen, 1987). Those AI systems face other major problem related to the use of proprietary formats to store social and user metadata. In his dissertation *Designing User-Centric Metadata for Digital Snapshot Photography*,

Sarvas (2006) alerts of the problems related to how companies could be using these proprietary formats in order to keep users in a specific service or software.

1.5.4. Mobile Ubiquity as the new rule for everything

Smartphones have put a camera in the pocket of most of the population. Nearly all smartphones, with the only exception of some security-oriented phones, have a photographic camera. Also, smartphones are the most widely spread technological tool, with predictions pointing that 80% of the adult population will have one by 2020 (Evans, 2015). Many authors have discussed the ubiquity of photography (Petrelli, Bowen, & Whittaker, 2014; Wells, 2015; Fetveit, 2013; Prieto, 2016) and there is a high consensus in how image-making has become an ordinary aspect of people's live (Hand, 2012). This permanent presence of photography in people's lives pushes research of social, cultural and technological change to pay close attention to ordinary aspects of user's habits (Shove, 2003).

It is also distinctive of smartphone photography, how this ubiquity happens at both sides of the camera (Lindley, Durrant, Kirk, & Taylor, 2009). People not only use their phones to take photos but also to watch them. That means that people not only carry a camera permanently, but they also a photo album. That forces the photo album, a physical object that was traditionally located at home, to an environment of ubiquity. Photos are shared from and to smartphones allowing social interaction in both long distances and times (Sarvas & Frohlich, 2011). This entire new situation makes it complicated to apply some of the previous models and research assumptions used in the research of domestic photography in the era of digital cameras. The PhotoWork model that has been a reference in the field for the last decades (Kirk et al, 2006) faces some problems when we try to apply it to the current smartphone situation. PhotoWork model was linear, and today's scenario is much more complex, with users facing multiple photo sources, uses and habits. Recent work by Broekhuijsen et al (2017) reviewed PhotoWork model and proposed a more efficient model, called PhotoUse, based on photo activities that better suit the current habits of mobile photo management.

This simplification of the photographic infrastructure (Sarvas & Frohlich, 2011) results in a series of security problems. The first one is that mobile phones are not a reliable place for long-term information storage, as the replacement rate of smartphones is very short or they get easily lost or broken (Recon Analytics, 2015). Cloud services are the most common solution and most of the cloud users employ it to store their images (Ofcom, 2015). The use of cloud services, together with the multiplatform approach of most of the cloud services, improves the safety of both smartphones created images and smartphone storage images. However, having a safe copy of all the images that pass through a smartphone only fixes the problem of backup, but not the photo management issues that smartphone users face daily.

Unifying the whole photographic infrastructure also means that photo curation must be done quickly on the smartphone or tablet and this process requires triggers that encourage the user to do it (Zürn, Damen, van Leiden, Broekhuijsen, & Markopoulos, 2018). Photographs have proved to be a powerful trigger for memory (Chalfen, 1987) (Whittaker et al, 2009) and systems should find the balance between the desire of people to control when to see the photos and which photos they want to see, and the joy of discovering old memories (Odom et al, 2014). It is also essential to have in mind that there is an important new group of users that will have their first camera in a smartphone. This new group of users, mostly from developing countries, might not have the tradition of creating a family album or at least not in the shape that most of the occidental research has worked. Hence, during the design process it is essential not to take for granted aspects that could be directly linked to the tradition of the photo album as a product that is exclusive of the Kodak culture, as those might not be well understood by the user.

1.5.5. Context, Metadata and Standards

Sarvas's (2006) PhD dissertation, where he discussed the role of metadata in phone photography, was clear in its conclusions: there is future, and need, for metadata in snapshot photography. Some standards have been helping to keep that metadata readable by different systems. The EXIF standard, developed by JEITA and CIPA can store

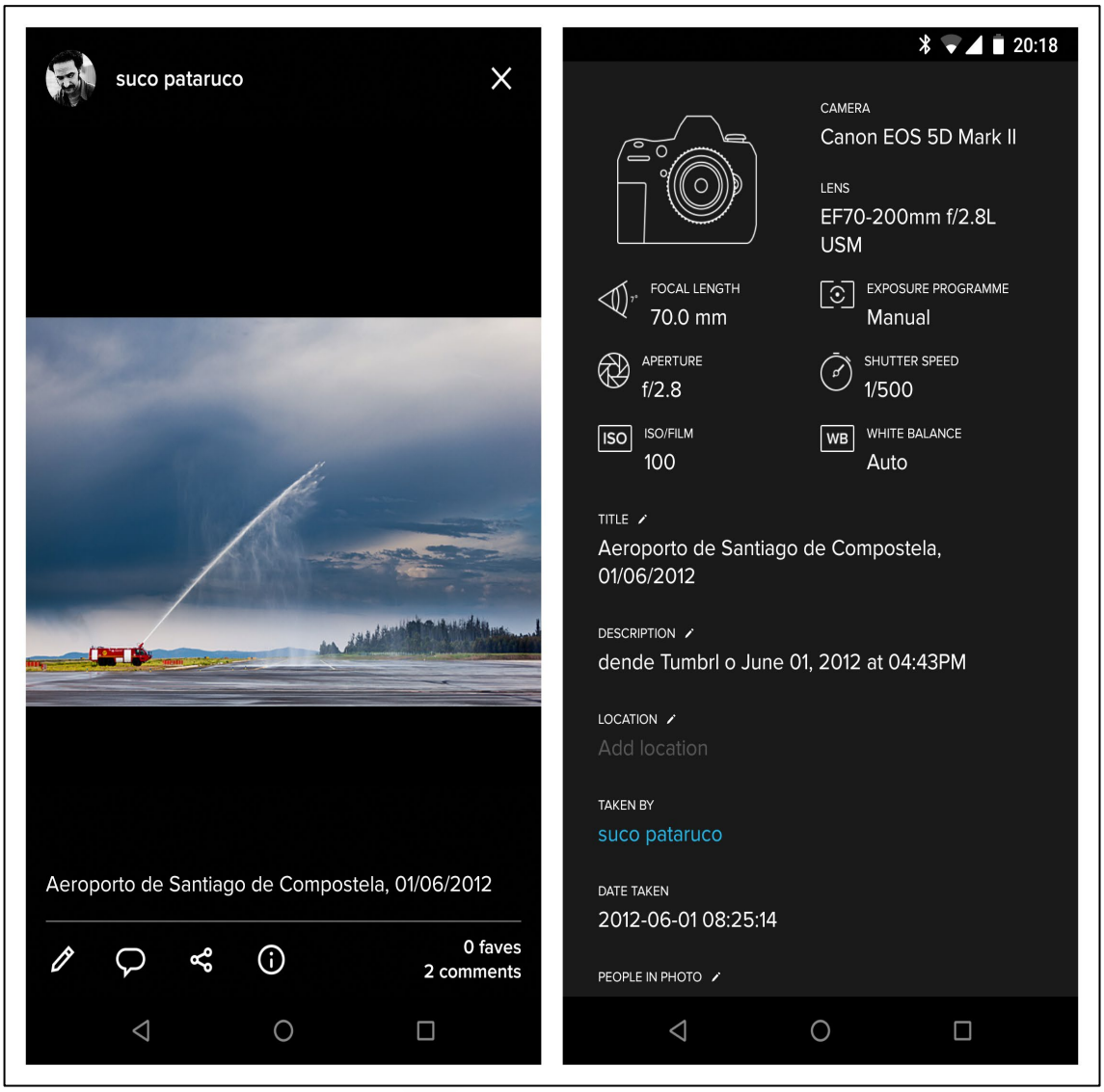


Figure 13: IPTC and EXIF data originally stored on the jpg file is shown on Flickr app for Android. This app includes icons that help user understand the meaning of the different values that EXIF information can show. (CC Andrés Fraga. Screenshot of the software installed on an Android phone)

technical information from the camera, such as exposure, aperture or camera and lens type, as well as the date and location (CIPA, 2018). The location is widespread and easy to obtain in the case of smartphones, but less common in DSLR or compact digital cameras, as very few models on the market include an active GPS. Other standards and applications support IPTC, including Adobe XMP sidecar file and DNG open raw format, very common in professional photography. IPTC allowed storing description and

keywords, among other information that is usually filled by the author of the images (IPTC, 2018).

Figure 13 shows information from both EXIF and IPTC metadata present at FLICKR'S Android app. FLICKR is a service originated in the amateur photography sector, so it is more prone to use tools and procedures that are originally designed and implemented in professional photography. Amateur users have specific interest in photography and usually welcome more the use of some of the professional tools even if they are more difficult to handle.

Recent advances in Machine Learning and Image Recognition allow current systems to describe, with a fast-growing accuracy, the objects in the photograph: 'cat', 'tree', 'car'. More complex interplays between those results allowed some of the systems to recognise such as events as weddings or holidays. However, most of the information that people remember from those photos is not physically represented in the image, neither objects nor people; it is the context around the image. To make it even more complicated, people are not always right in what they remember (Bentley, Kaye, Shamma, & Guerra-Gomez , 2016). That leaves us with a possible situation where users might be asking the systems to find a specific photo, but the search information provided by the user to the system is entirely wrong. Despite this fact, technological advances could assist with organisation, but only if people are able and willing to use them (Whittaker et al, 2009).

Previous research on multimedia content analysis has suffered from the assumption that converting images in text should be a fully automatic process that avoids user involvement (Davis, King, Good, & Sarvas, 2004). However, studies have shown how the increased exposure of users in the maintenance and curation of their photo collections help solve the problems users have in their long-term photo retrieval (Whittaker et al, 2009) and how the value of the image is related to their effort in preservation. (Chalfen, 1987).

It is essential to understand that contextual information in the form of annotations was already present in Kodak culture. Traditional photo albums used to have a date or some annotation with some necessary information (Figure 12.). Oral comments then

complemented this information. The same happens with detached images stored in shoeboxes or envelopes, which used to have some comments in the back of the image (Frohlichet al, 2002). It is crucial to understand that the way the images are organised, as well as the relation those images have between then and the contextual information related, is an essential information for conveying their real meaning. As explained by Martin Hand:

> The differences between traditional and online albums have implications for the processes of memory-making and for the transformation of circulated images into "fixed" ones. As an archivist will tell us, the precise order in which an album has been constructed, and the ways in which particular images are placed in relation to one another and the album as a whole, form the key to understanding the contextual meaning of any one image rather than its specific content (Hand, 2012).

Current systems have developed different ways to add and manage contextual information. However, it seems that all the current solutions are still reliant to some extent on the involvement of the user. Meanwhile, it remains unknown if current technology will evolve sufficiently to either totally supersede the role of the user or to be a tool that helps and encourage the user to do their role as responsible an image curator of their memories.

1.6. RESEARCH METHOD

The theoretical foundation of this study is provided by the methodology used in previous studies in the field of photo management, both qualitative and quantitative. This study aims to offer a more transversal view over this field. For this purpose, it requires the use and understanding of different methodologies from the academics and the industry.

In the last chapter of their book *From Snapshot to Social Media – The Changing Picture of Domestic Photography*, Risto Sarvas and David M. Frohlich (2011) wrote a sentence that could correctly summarize the philosophy behind the methodology of this study:

> A piece of technology without a user study is considered half-done, and a study of people using technology is also unfinished unless there is a discussion of how to apply the knowledge created, in building new technology (Sarvas & Frohlich, 2011).

With this transversal view in mind, we have organised our research to look at two main directions, both people behaviour and technology application. Each insight has its own chapter in this thesis. Similarly, following the description by Joyce Yee of her research approach for her PhD The researcherly designer / The designerly researcher (Yee, 2017) I applied the experience I gathered over a decade of work as a photographer and editor, managing photo collections with hundreds of thousands of images from very different sources and applications. The experience and the problematics while managing the photo board of a newspaper, a digital magazine or the own archive as a professional freelance photographer has helped me with the important questions needed at the beginning of any research, as well as for the proposed solutions and the discussion required for analysing the obtained data. Another feature of this research is that all the participants involved are affected by the research topic itself, as they are smartphone users that need to manage their personal photo collection.

In Chapter 2, where we study people habits on photo management on mobile devices, we have followed part of the methodology used by Richard Chalfen (1987) in his *Home Mode Questionnaire, A Study of Family Photography*. Even though we should not understand our questionnaire as a version of Chalfen research, we have designed our survey building over his experience. Other researches that work around photowork and photo management (Kirk et al, 2006; Rodden & Kenneth, 2003; Frohlich et al, 2002) where fundamental to bring some of the tools and methodologies of Human-Computer

Figure 14: Conference "The Explosion of Imaging" at Mobile World Congress Barcelona. Moderated by Dan Rubin, Editor at Large, Photographic Journal and with John Van Derlofske, Senior Research Scientist at 3M, Bernardo Hernández, General Manager at Flickr, Samuli Hanninen, General Manager at Microsoft and Sokratis Papafloratos, Founder & CEO of Togethera. (CC Andrés Fraga)

Interaction studies to this research, having the UX very present, both concerning the technological approach and the users' behaviour and experts' consultations.

1.6.1. Research structure: Three blocks for three points of view.

Understanding the current state of a field that is moving fast is a challenge. When it was decided to work in the field of smartphones, the first problem we faced was defining "current". In an already fast-changing sector, as the mobile technology and apps are, image management has experienced a fast growth in interest during the six years of this research. Those leading industry players who have had some relation with photo taking and storing, such as phone manufacturers, operating systems, social networks, apps and

cloud services, reacted to the problems users faced and started a race to win the users' trust to manage and store their images. One notable example of that is the conference "The Explosion of Imaging" at Barcelona Mobile World Congress 2015, where CEOs and high directives from companies as FLICKR and MICROSOFT discussed the importance of image in the future of mobile devices (Figure 14).

The methodological approach used in this research combines qualitative and quantitative methods building on the experience of domestic digital photography. We have decided to implement this combination of methods based on some of the previous works we have mentioned. Using triangulation (Denzin, 1978), we aim to reinforce the results of our research while keeping a multidisciplinary view at the problematic of photo management. After having consulted the necessary literature and located the leading authors and opinions about photo album and snapshot photography, we decided that we need a picture of the current situation on how photo management is on smartphones. We resolved to start our research by facing a series of general assumptions, commonly use on media (Newton, 2015) and general opinion about user habits on photo management on smartphones with some trusted data. We created a survey focused on smartphone use to verify this previous hypothesis. Details on the construction of this survey will be further explained in Chapter 2.

Once we processed the results of the survey, we used the information collected from previous works to obtain a series of preliminary conclusions about what are the current habits and needs of smartphone users regarding photo management. With these preliminary conclusions, we created a framework of users' needs in snapshot photo management. It was from this framework that we constructed the next phase of our research, facing it with the current solution that most commonly used systems offer to manage photo collection in smartphones. To do so, we collected a series of services and apps of the most common mobile OS and "asked" them a series of questions to check how they face the user's needs. In Chapter 3 we explain in detail how we have organised this study.

At this point of the research, we had information from three sources: previous reviewed theoretical literature and empirical studies, a survey about user habits and a study of the system's features. We could try to confirm or disprove our hypothesis, but, as we have explained before, we wanted to have a cross view of our topic. Is for that reason that we decided to add the opinions of a panel of experts from different fields to the research. We chose experts from both the academic world and the industry, who had investigated and worked in the field of personal photo management. We selected a semi-structured interview approach in order to give the experts enough freedom to take our questions to their field of expertise and allow them to surface new topics and points of view. In Chapter 4 we will explain more in detail the method of this phase of the research.

The other reason why we decided to add the expert's point of view is that we are conscious of the speed of the technological changes and therefore, the volatility of the data we analyse, especially concerning the systems. During the period between the performance of the system analysis and the writing of the conclusions, some functions and main characteristics had already changed. The long-time experience of the experts has provided data to our research that does not expire so fast.

We are therefore using four typologies of data: previous studies, users' opinion on their needs and habits on photo management, software functionalities of photo management apps in different OS and expert opinions on our prelaminar conclusions. Although the data in the second and third sources are different, as one is users view and the other is software options, we understand that both are offering information about the same problem we face here, and therefore, are two valid sources of data for us. In the case of the interviews, we consider that it is a more precise case of data triangulation as our experts face similar questions that the ones used with users and systems.

We have also used methodological triangulation in our research. We have resorted to questionnaires to obtain information from users and systems. There are apparent differences in the way those questionnaires have been executed, as people and systems are, of course, very different sources, and systems cannot literally “answer” the questions. However, the principle is in both cases a survey with a questionnaire. In order to obtain

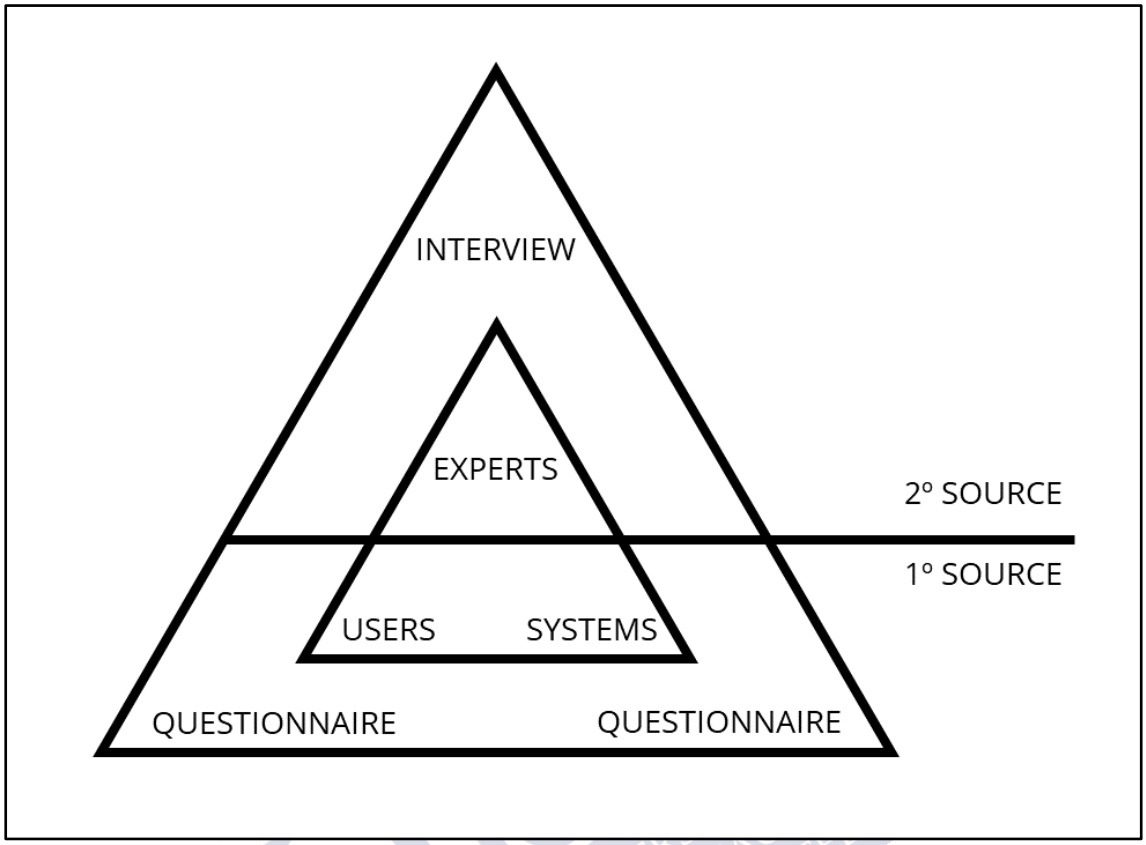


Figure 15: Our approach to triangulation with both data triangulation and methodological triangulation. (CC Andrés Fraga)

information from our panel of experts, we have used interviews instead. In all those three cases, the topic of research has been the same. The reason for choosing interviews with the expert panel and the type of interview will be further explained in Chapter 4.

Despite using tree sources and different methodologies of research, it is essential to emphasise that not all the data sources have been treated in the same way and the relation between the different sources has not been equal. We have organised our research in order to obtain a set of data from our two primary sources, being those user data and systems data. We have collected and study this data until we have obtained a series of previous conclusions. It is with those preliminary conclusions that we analyse in the last part of our research. We used the information from existing literature on the topic together with our results to prepare the base for our expert panel interviews.

As we explain in Figure 15 we approached triangulation in two different ways, but understanding that the whole research was divided into two phases, where the first part creates a collection of results that are used as material to create new data for the second part of the research. We have designed the second part, the expert panel, as a tool to both to validate our conclusion as well as to have an even broader approach to a field that we understand that needs a cross-discipline view. The proved long experience of the experts chosen for this research also helped to provide less time-dependent conclusions, as we have previously seen how variable the current environment is.

CHAPTER 2 SNAPSHOTS ON SMARTPHONES

2.1. NEW HABITS IN SMARTPHONES PHOTO MANAGEMENT

The affordability of consumer digital cameras and the zero cost per picture was one of the critical factors that have determined their success (Gómez-Cruz, 2015). However, the adoption of new technology does not only depend on the hardware related to it as well as the services it can provide and their success. Since the digitalisation of photography, the components of the domestic information and communication technology (ICT) infrastructure have practically become consumables with a very short life cycle (Sarvas & Frohlich, 2011). Concerning the replacement cycle for smartphones, the time for substituting them was becoming shorter and shorter up until 2017, when it has started to slightly recover. As an example, in the US, the average replacement cycle at the end of 2017 is 25.3 months (Fowler G. , 2018).

How this constant change and evolution in hardware and technology affects the way people use their devices? People's habits usually change slower than the technology they use, so after 20 years of the constant evolution of domestic photography, it is difficult to presume the users' habits. This change is not only due to the traditional Kodak culture user turning to digital cameras and then again to smartphone cameras. It is essential to have in mind that the next billion people that will have a smartphone, most of from developing countries, will probably jump the two previous steps. Their smartphone will be their first camera. This is also happening with the new users from developed countries,

as most children will have a smartphone before having a camera. With this in mind, we believe mandatory to have a clear view of current habits in smartphone photo management before digging deeper into our research.

Although we have focused our research in a mobile-first or even mobile-only scenario, where the user creates, edits, organises and shares all their images with and within a smartphone. It is also instrumental to remember that a portion of the population already has a digital photo collection with more than ten years of remembrances in it (Ofcom, 2015). These users have images from various sources and formats in their digital collection and they have been storing and organising them in different ways in those last years. In a probable scenario where personal computers will be replaced for mobile devices like smartphones and tablets (Evans, 2015) it is key to create a system that can manage all the variety of pictures users might have. From the new images created, sent and received by smartphones, to old digital photos made in the early years of photography, as well as the old analogue photo collection that might be digitalised, they all must find a way to coexist.

2.2. CURRENT USE OF PHOTOS ON MOBILE DEVICES.

In general discussions about photography and mobile phones, several assertions are often made and understood as evident. The veracity of some of them can easily be worked out with a fast search of data on the Internet. In most cases, many charts might show up supporting some of the classic statements such as the increasing number of photos shared on social networks, the use of cloud services or sharing habits. However, in order to obtain a better view of the current photographic habits of a smartphone user, we decided to use some of those assertions as the hypothesis for our research. Those assumptions were based on the author's experience, both professionally and as a snapshot user. It was also important a series of conversations with users and experts developed during the first periods of this research and in previous works around smartphone photography (Fraga, 2013, 2012). We had organised and unified these hypotheses into eight groups

- Users have too many pictures.

There are previous studies that confirm that the inclusion of cameras on mobile phones has increased the number of pictures that users take (Van House, Davis, Ames, Finn, & Viswanathan, 2005). The ubiquity of the smartphone (Kindberg, Spasojevic, Fleck, & Sellen, 2005) opened the utilisation of the camera to a variety of new usages that were not possible with a camera before. This has increased not only the number of photos taken as well as the moments or objects that are being photographed.

The primary concern here is whether the current increase in the number of pictures taken by each user may lead to a point where the number of images is higher than those that a user with the current systems can handle.

- Users have more than one source

Unlike standard digital cameras, taking pictures is not the only way to have images stored on mobile phones. Emails, messaging apps, social networks and even screenshots are channels through which images can enter mobile phones. In most cases, the file type is the same: jpg, png or gif.

- Users have more pictures than those that they have taken

This hypothesis, directly related to the previous one, states that users have more pictures than those they have taken. The channels above-mentioned work as an entrance to pictures created by friends, family, celebrities and even unknown people. We hypothesise that those images are managed in the smartphone in the same way as those taken by the users.

- Users do not have all their pictures in one single place

Mobile phones manufacturers and software developers have used different methods to extract and store the images taken with mobile phones out of the devices. From cables to infrared, Bluetooth or cloud services. We believe this variety of methods, the increased frequency of technological advance and the lack of an enduring photo ecosystem has

dispersed the images of the users along with computers, external hard drives and different cloud systems.

- Users take pictures outside “events”

Snapshot photography implies a high level of spontaneity. Still, most of the photos made by domestic users were about specific events of importance such holidays, birthdays or weddings (Chalfen, 1987). Sometimes those events did not have to be extended in time like a holiday or last the whole day like a wedding, but they did have a substantial value, like every “first” in the life of a young child's life.

- Users have more pictures than those they can watch

Relying on the hypothesis that users cannot correctly manage the vast number of pictures they have on their phones, it can be assumed that they do not have a way to review all the images they have created. As Kirk et al. (2006) pinpointed in *Understanding Photowork*, people review photos from only a few folders and only a group of those photos. Under that premise, we can hypothesise that users have a limit on the number of pictures they can watch and the number of images they have on their devices is higher than that limit.

Even though photographic cameras became popular in western society and were common in most households in the second half of the XX century, cameras were not a daily use tool. Cameras were taken ad hoc to document those unique events, as mentioned above. With the integration of cameras in mobile phones and their constant use, they have become a tool that is permanently accessible by users. Therefore, the “events” system that used to be applied in digital photo management is no longer useful to most of the users.

As Kirk et al. (2006) pointed out, the chance of always having a camera has increased the flexibility of photo practice. This ubiquity implies a more sophisticated use of the camera and, therefore, more complex photo management.

2.2.1. Use of traditional album

The photo album was used as a place to store snapshots and domestic photos for more than a century. Together with shoeboxes and photo displays, albums were the space to organise family events and experiences in a timeline that worked as a guide to family memory and identity. Photo albums preserved the memory as much as they were tools to create memory. Images, as well as annotation and oral comments, expressed around the album in family meetings, worked, in the words of Jo Spence, to construct family and biographies (Slater, 1991).

However, now that most of the snapshots are made with smartphones, we raise the question of what will happen with the traditional photo album. We wonder if people are adopting the mobile infrastructure to feed the traditional album and if they are still using photo books and digital albums to have physical copies of their images. We hypothesize that users have turned their back to the traditional photo album and that the penetration of photo book or digital albums is not significant enough to cope with the desertion of users from the traditional album.

2.2.2. Our pictures will not survive us

Digital photography meant a technological disruption that is still recent and the appearance of mobile photography has changed some of the foundations of camera use again. This disruption has prevented the consolidation of a new technological path that can guide and give stability to current photo management platforms.

The constant birth and death of photo management systems forces the user to change and move their information to keep it safe. This fact not only affects the information in the shape of files and photos, but also the context and the information archive surrounding those images. This is basic for a right use of the images and it is more exposed to get lost in between the platform changes.

To sum up, this research aims to examine the current habits of use, management and safety of smartphone pictures according to different variables such us age, gender, experience and paternity.

2.3. SURVEY DESIGN

This research is a descriptive study that was developed as an *ad hoc* web-based self-administered survey, organised in three blocks: personal information, type of images and management methods, with a total of 12 questions. The answers were multiple choices with an open question option in some of the cases. In blocks two and three, users can choose more than one option. English and Spanish versions were available. The survey was built on GOOGLE Forms platform, and it was set to be of public access for two months. The research project was publicised by using social networks and mailings inside the University of Santiago de Compostela. The survey was live for a period of two month and was completed by 359 people.

IBM SPSS Statistics 20 was used to analyse the data. Data are shown as frequencies for categorical variables and medians (and interquartile range, IQR) for continuous ones. U-Chi-square test was conducted to compare categorical variables. MICROSOFT EXCEL was utilised to create a table to filter and analyse cross data and to create most of the charts shown in the research. More complex charts, like Figure 30, that uses data from 4 variables, were created using Tableau Public, a software that allow to create complex data visualisation.

This statistic analysis of the data of this chapter was performed with the cooperation of Maria Azul Forti Buratti, PhD in medicine by the Universidad Autónoma de Madrid. A simplified version of this chapter was published in both digital and printed versions of adComunica nº13 in January 2017 (Fraga & Forti Buratti, 2017)

Question	Answers
How old are you?	18-24
	25-34
	35-44
	45-54
	55-64
	>65
Are you:	Female
	Male
Do you have children under 18?	Yes
	No
When did you have your first smartphone with a data plan?	Less than 2 years ago (after 2013)
	2-5 years (2010 2013)
	5-8 years (2007 – 2010)
	More than 8 years (before 2007)

Table 1: First some info about you.

2.3.1. Personal information

One of the aspects of this technological disruption is that it will affect differently to different generations and this contrast is expected to be very characteristic. To deal with that, the survey started by asking the age of the participants in 7 blocks of ages based on the system used in the Ofcom Communications Market Report (Ofcom, 2015). The first block of age was finally not included in this research because of the low number of participants. Gender was also included, as women, especially mothers, had a vital role in the creation of family albums and photo management (Sarvas & Frohlich, 2011). For this same reason, and for the importance that paternity has in the starting of an album (Chalfen, 1987), a question about the parenthood was also included, specifying if those children were less than 18 years old, as it is assumed that adult children do not influence in the album creation in the same way.

The last question of this first block was intended to collect information about the level of experience in the use of smartphones, asking when they had their first smartphone with an Internet connexion. This question was included to help to understand the exact concept of a smartphone to all the participants.

Question	Answers
When do you use your phone to take pictures?*	At special events (birthdays, holidays, weddings, etc.)
	To take notes (recipes, a brand of wine, clothes at a showcase)
	To speak with friends/family (ask for advice about a piece of clothing, show where you are via apps like WhatsApp)
	To document spontaneous and everyday moments
	To share moments with absent friends and family
	Other:
On the memory of your phone you might have pictures that came from different places, mark the ones you have.*	Camera
	Mail
	WhatsApp or similar apps
	Screenshots
	Social networks
	MMS
	Other apps
	Other:
The pictures you have stored on your phone where made by:*	Me
	Family
	Friends
	Celebrities
	Unknown people
	Other:
	Phone memory
* Participants can choose more than one answer.	

Table 2: Now let's see how you use the photos on your phone.

2.3.2. Typology of photos and new uses of the camera

These questions were aimed to understand what kind of pictures people have on their phones by asking the respondents when they use their phone to take pictures.

The answers related to special events included three options that had a direct relationship with the existence of smartphones as “take notes” and “speak with friends”. The fifth option, “To document spontaneous and everyday moments” aims to find if having a camera always on you would push people to take more spontaneous photos. The last answer wanted to find if in some situations users take photos with sharing as the main goal.

The objective of the second question of this block was to validate the hypothesis that users have many sources, by asking where the pictures they have on their phone come from, if they were created by the phone (camera and screenshots), and whether they ended up there through the Internet (mail, WhatsApp or similar apps, social networks or other apps). MMS were also included, though it is a technology that has fallen into disuse, to check if it is still a system with a significant enough number of users to take it into account in future designs.

For the last question of that block and following the same purpose of hypothesis validation as the previous one, participants were asked about the authorship of the images they stored on their phone. Apart from the owner, family and friends (Ofcom, 2015) “Celebrities” and “Unknown People” were included to understand if the user was collecting photos with no personal value.

Question	Answers
Where do you store the pictures you made with the phone?*	Computer
	External hard drive
	Cloud Service
	Social Networks
	I print them
	Other:
	OneDrive
If you use a cloud service to store your pictures, could you specify which one?*	Google Drive
	Dropbox
	iCloud
	Box
	None
	Other:
	Facebook
If you use social networks to store your pictures, could you specify which ones?*	Instagram
	Twitter
	Pinterest
	Flickr
	Pix500
	None
	Other:
	Print it
When you have a particular photo you love and you would like to keep, what do you do?*	Post it in social networks
	Save it to your computer
	Nothing
	I don't know what to do
	Other:
If you think of all the pictures you have on your phone, do you think you have seen, at least once, all the pictures after you took or downloaded them?	Yes
	No
	I don't know
* Participants can choose more than one answer.	

Table 3: We will now see how you organise your pictures.

2.3.3. Management method, use of clouds and social networks

This block aimed to understand how people manage their images on mobile devices, to know where they store them and how they handle to keep them safe. In that sense, the three first questions sought to understand where they store their pictures, and mainly, if they use cloud services and social networks to do that and which are the services they use in that case.

The selection of the cloud services was made following criteria of popularity and affordability and if they offered specific features for photo storage. The option to choose "Other" was included to find if some other services were not being considered and they were also be used. In the case of the use of social networks use, the most common ones in Europe and some of the most used photo-orientated social networks as FLICKR and Pix500 were offered. Even though this research was poraimed to understand the habits of the users without specific photographic skills or affinity, it was considered relevant to find if some of those services, initially orientated to "amateur photographers", were also being used as an alternative to manage their images by snapshot users without a specific interest in photography.

In the next question, the respondent was asked what he or she would do if there were a photo he or she loves and would like to keep. The aim was to find if there is a difference in photo management when there is a specific image with more added value. Respondents could choose between "print", which would represent a solution close to the traditional album, and another purely digital solution. The idea is to find if the editing process of the curated images is still being done by using systems close to the traditional album, or it is not being done at all. The answer "I do not know what to do" tried to find whether there is a situation of frustration in the photo management (Whittaker et al, 2009). Again, one answer was left open to find new alternative ways users might be using to manage their most precious images.

The last question was intended to demonstrate the initial hypothesis that people have more photos than those they can manage by asking the users if they have pictures taken

Question	Answers
You have probably seen pictures of you parents and grandparents in photo albums, do you think this will happen in the future with the pictures you have now in your phone?	Yes
	No, most of the pictures in my phone will probably get lost
	No, I don't think the pictures in my phone are relevant
	Other
Do you still create physical photo albums with pictures from your phone?	Yes, I print the pictures and I compose an album in the traditional way
	Yes, I use an online service to compose and print the album (Hofman, Apple, Blurb, etc.)
	No, I don't make physical albums any more
	No, I don't use mobile photos for my physical albums
	Other

Table 4: And now let's finish with a couple of questions about photo albums.

with their smartphones they have never seen again. That would also help understand the use-cycle of photos inside the mobile phone.

2.3.4. Photo albums and the long term

The idea behind this last block was to reveal the relation that users have with the traditional album. The first question asked the users if they still create physical albums with pictures from their phones. That would include pictures taken and receive by phone. There were two positive and two negative options to answer. In the case they did create a physical album, they could choose between albums created in the traditional way, by printing the images and composing them in an album, or by using some of the online services that allowed users to digitally compose and layout and album that will later be printed and send to their home. With these two affirmative options, we wanted to know if online services are a common alternative for those that want to have a physical album. In the case of a negative answer, users also have two options. They could say they do not create physical albums, or that they create physical albums but not with photos from their phones. Those answers could help us to understand the value that users give to their

smartphone pictures, and if they understand that pictures taken with a smartphone, as well as all the picture they receive in their devices, could have the same value than those taken with a digital camera.

Finally, the last question of the interview looked forward to revealing the level of trust that people have in current systems and if they believe their current management and storage methods would allow them to have a positive retrieval experience in the long term. To do so, users were presented with a typical situation. They were told that they probably had seen pictures of their parents and grandparents in photo albums and were asked if they believe this could happen in the future with some of the pictures they now have on their smartphones. Users could also select a positive answer or choose between two options if they wanted to say "no". Firstly, because they think those images will probably get lost in the future, and secondly because they believe that the images on their smartphones are not relevant.

2.4. RESULTS

2.4.1. Typology of photos

Concerning camera use, most of the participants made at least four different uses of their camera and 33% of them have at least five different ones, as shown in Figure 16. At the same time, most of the usages have similar percentages (between 61% and 68%). The usages described in the section “Other” were most commonly related to the use of the camera at work, as some of the users also utilise their company smartphone as a personal phone. If it is compared with the age of the participants, as can be seen in Figure 17, the percentages are quite similar. There are some exceptions with the youngest ones, since the most frequent use of the camera is conversation, while in the rest of the age groups this is the least frequent after Others

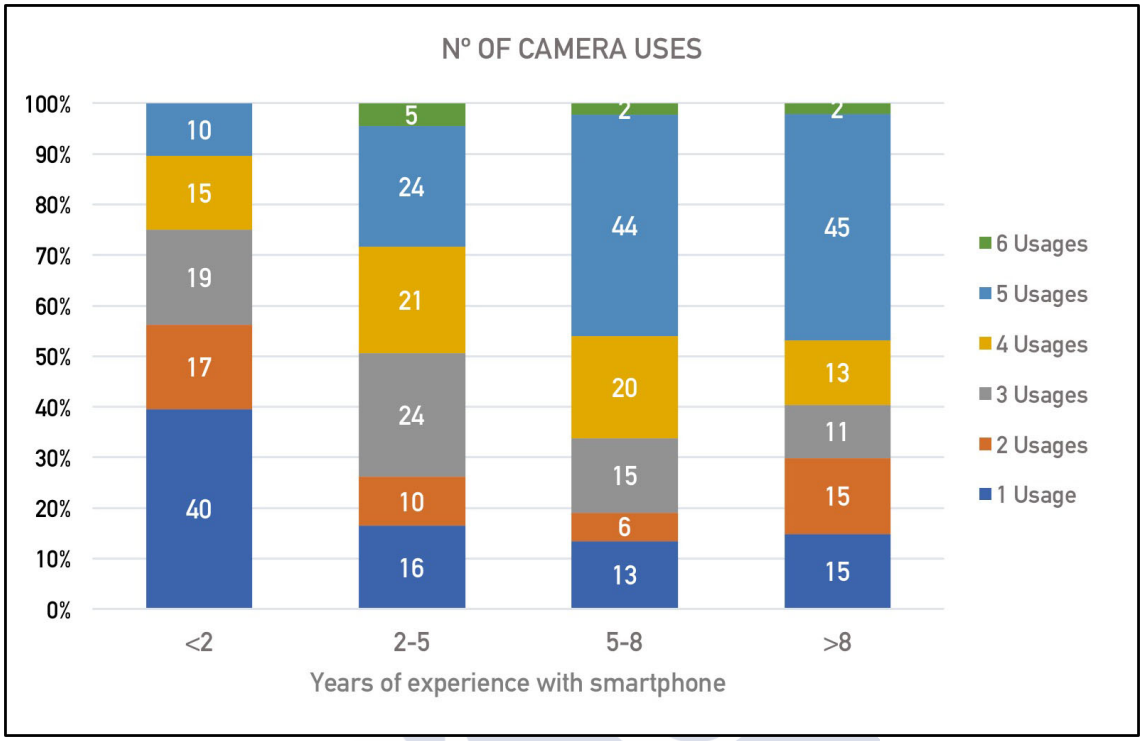


Figure 16: Nº of Camera Usages by Experience. (Reproduce from Figure 3 in Fraga & Forti Buratti, 2017)

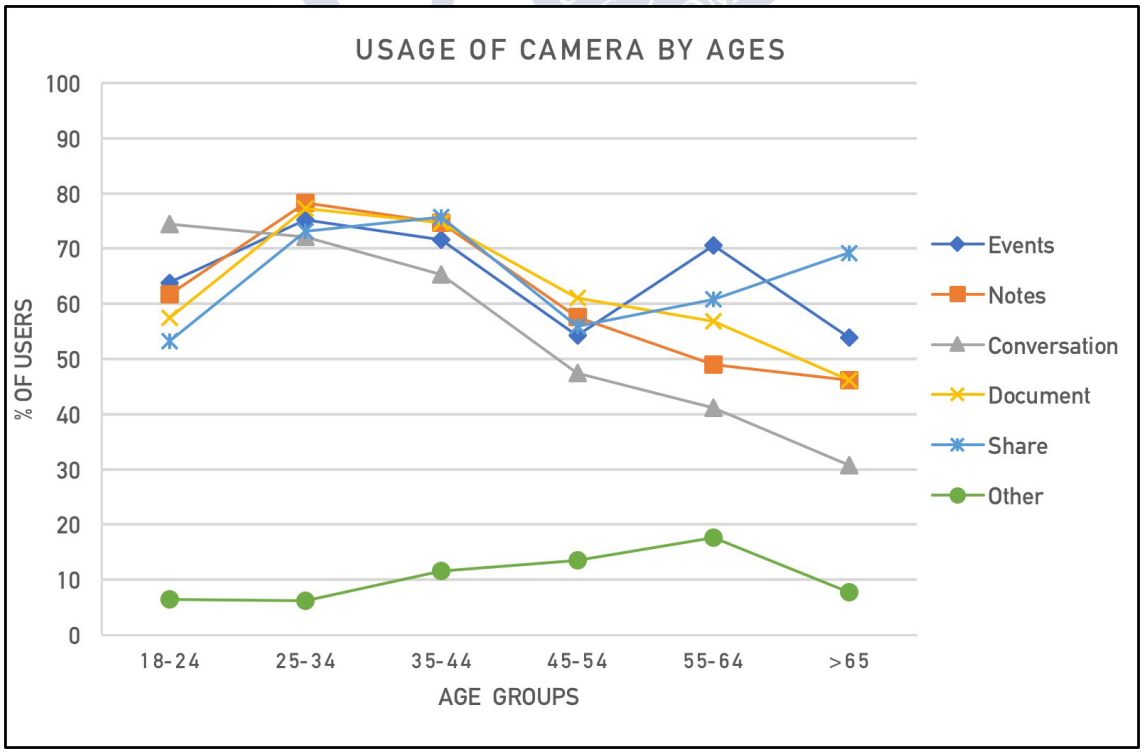


Figure 17: Usage of the camera by ages. (Reproduce from Figure 1 in Fraga & Forti Buratti, 2017)

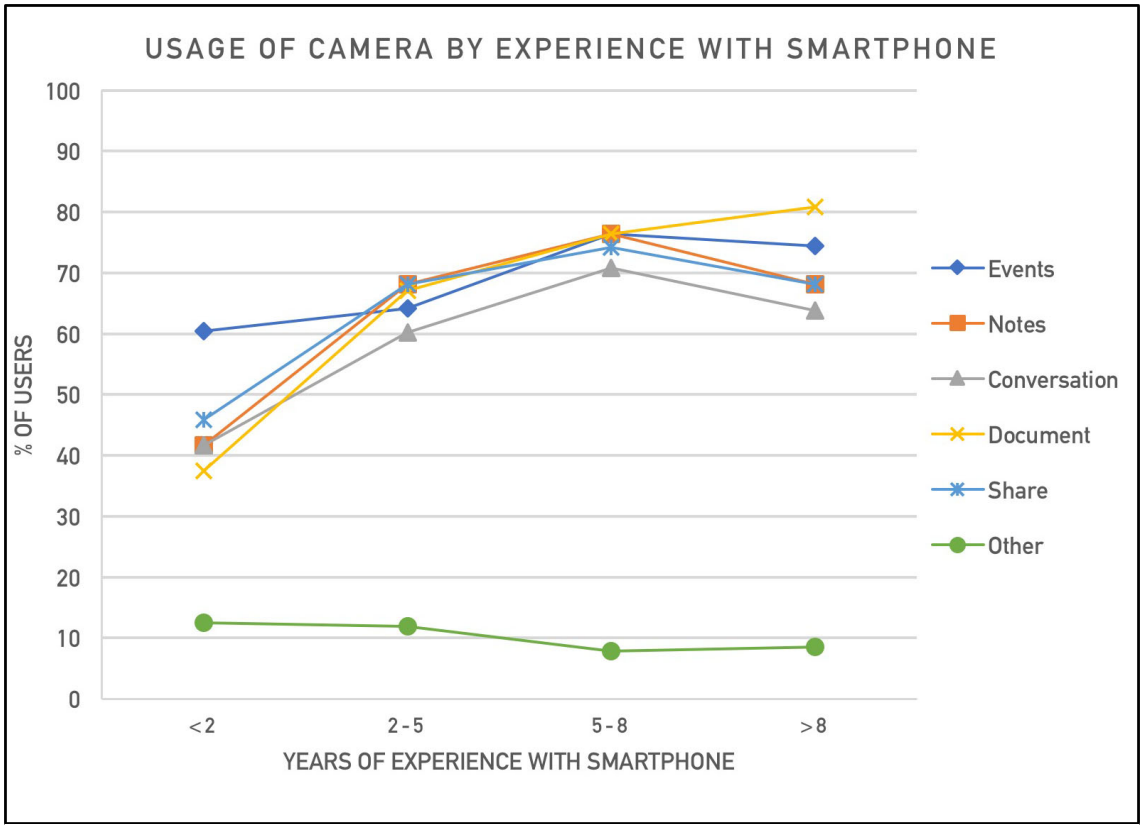


Figure 18: Years of experience with smartphone. (Reproduce from Figure 2 in Fraga & Forti Buratti, 2017)

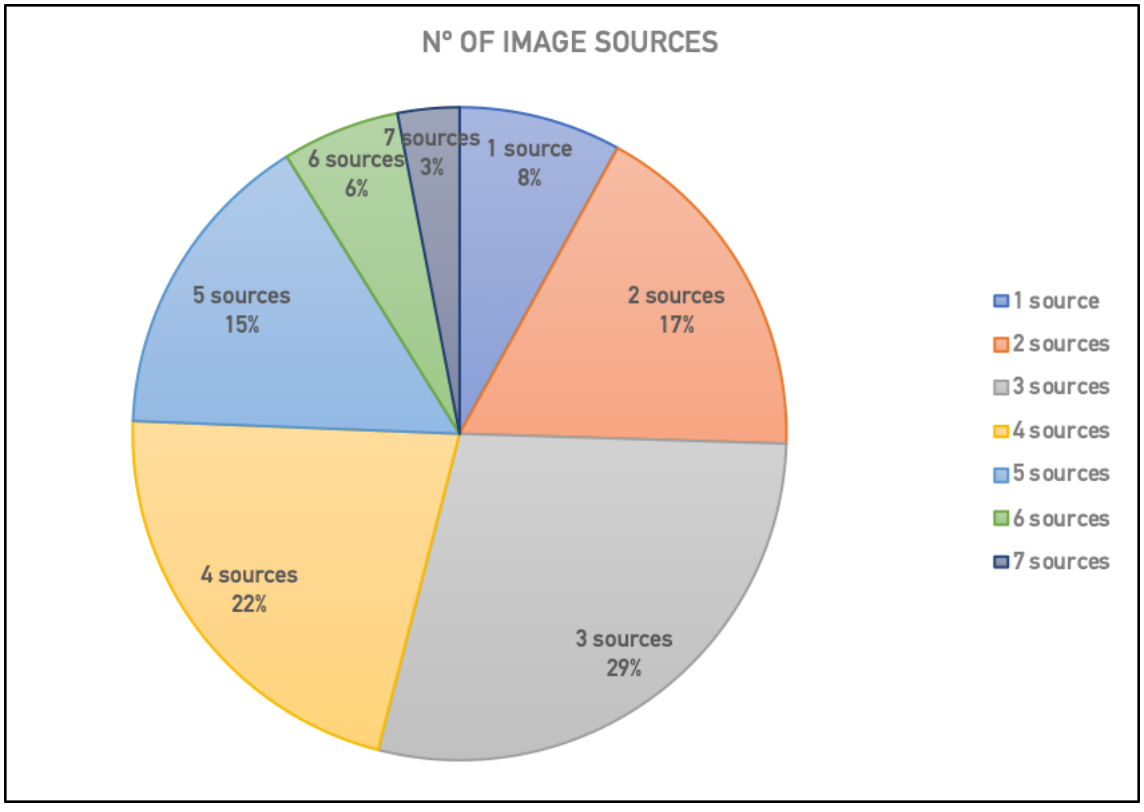


Figure 19: Nº of image sources. (Reproduce from Figure 4 in Fraga & Forti Buratti, 2017)

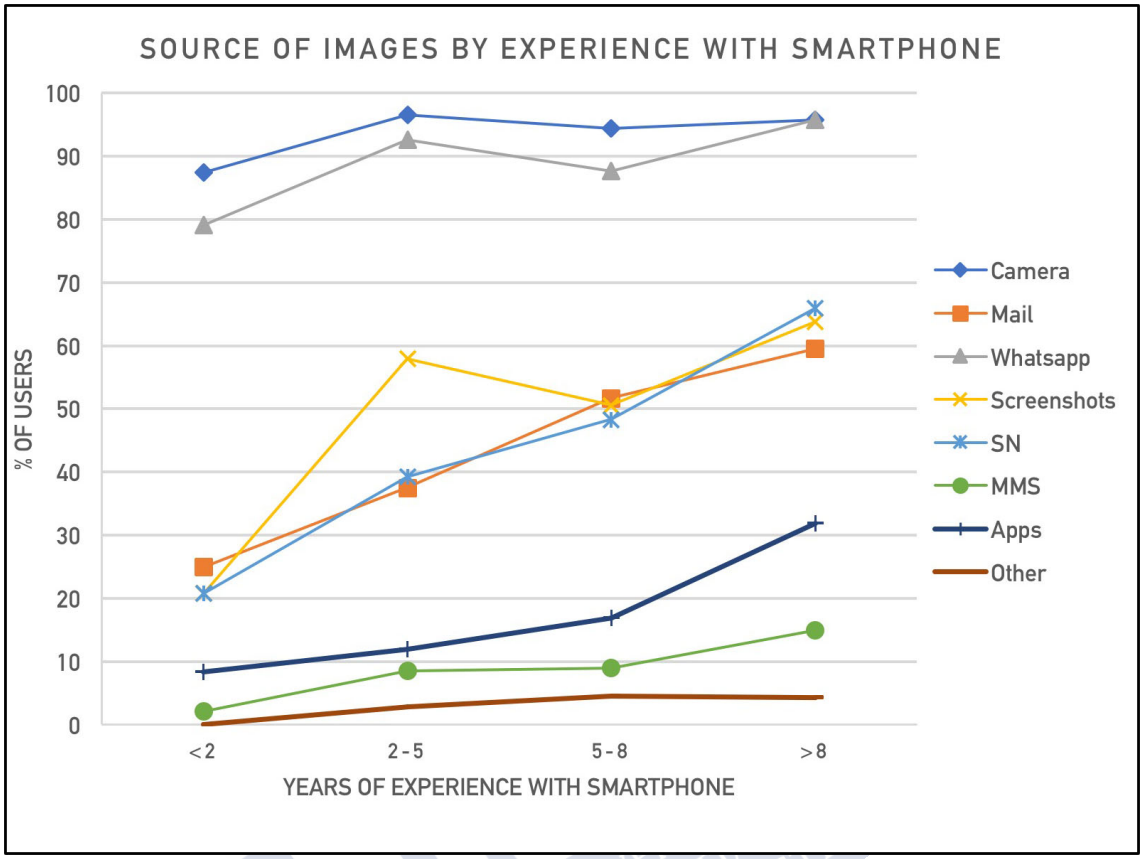


Figure 20: Source of images by experience with a smartphone. (Reproduce from Figure 5 in Fraga & Forti Buratti, 2017)

It is also remarkable how 40% of the less experienced users have only one usage of camera and the users with five usages of the camera represent only 10% of the group as we can see in Figure 16. However, 44% and 45% of the users with more than five years of experience have at least five usages for the camera on the phone. It is also statistically significant that users with young children are more prone to use the camera for conversation (16 points of difference and p= 0.031) and Document daily life (17 points and p= 0.001).

The usage of the camera is very similar among the different levels of experience, as shown in Figure 18. There is only a small difference in the use of a camera at special events (between 14% and 22% compared to the rest of uses) in the group with less than two years of experience. At the same time, users with more years of experience are more likely to use their phones to document spontaneous and everyday moments.

Concerning the origin of the images, smartphone cameras are still the most common origin of images on the devices, as 95% of the surveyed use them to take photos, followed by WhatsApp and other instant messaging apps used by 90% of the participants. Screenshots are used by 52% of the users, being more common among the youngest, as 94% of the participants between 18 and 25 years old use them, in contrast to only 25% of the participants older than 65. Social networks and e-mail are used by 43% and 42% of the participants respectively. MMS is still used by 9% of the users.

Reviewing the number of image sources, it is remarkable that only 5% of participants store in their device only those pictures taken by their camera, being three the most common number of image sources, as it is shown in Figure 19.

In Figure 20 it is possible to see how Camera and WhatsApp-like apps are very consistent as the most common source of images among the different levels of experience, while the use of the rest of the sources grows in use as users increased their experience. Users adopt the use of their smartphone as a camera very soon.

When analysing the authorship of the images, in Figure 21, it possible to see how Friends and Family (72% both) are the most frequent authors of pictures just after the owner of the smartphone. Only 16% of the participants have pictures exclusively taken by them. The years of experience with a smartphone does not affect directly to the authorship of the images, except for the number of pictures of Unknown author. Authorship diversity showed little changes according to age. It is possible to see in Figure 21 that there is a small difference in the number of young users that claim to have pictures of friends and older user. There are less older users that have pictures of friends, but instead, more have pictures taken by family members. There is also a progressive lack of pictures of an unknown author as the user gets older. It is also remarkable that images from celebrities represent only 1%. Furthermore, 53% of the users have pictures from 3 different groups of authors.

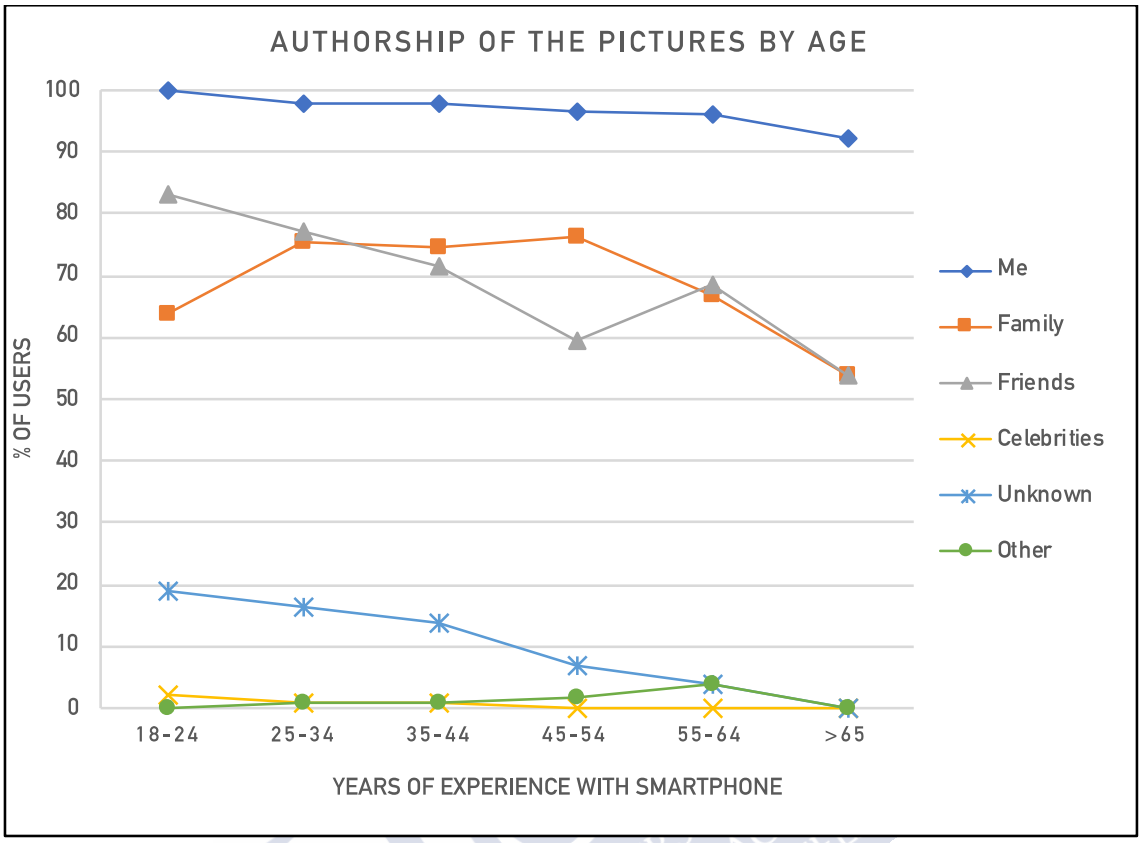


Figure 21: Authorship of the pictures by Age. (CC Andrés Fraga)

There is a statistically significant difference of 15 points (p= 0.001) between the percentage of users with children under 18 years old that have pictures taken by Family and those without young children (83% vs 68%).

2.4.2. Management Method

The results regarding the storage methods selected by users showed that just 12% of them keep their photos exclusively in their devices. Phones and computers are the most popular places to store images, as shown in Figure 22. Assuming that those could be considered the most unsafe places, as they are often outside the home and are exposed to more failures, we can merge the data of Phones and Computers, with results that show

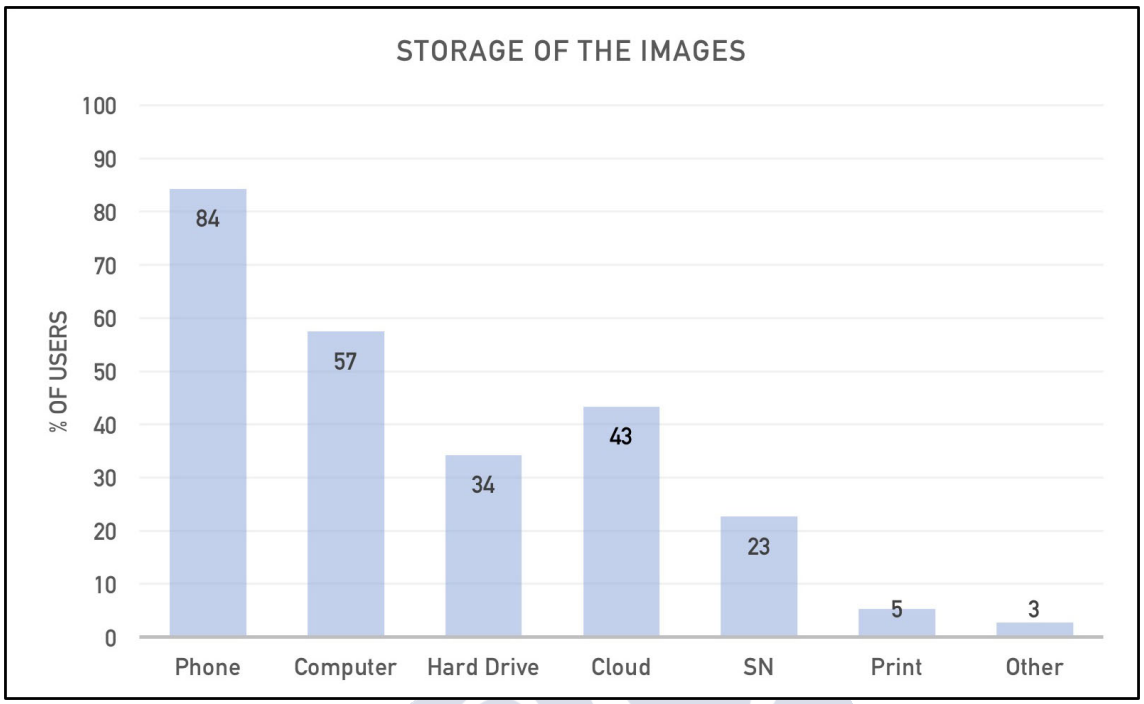


Figure 22: Storage of the images. (Reproduce from Figure 6 in Fraga & Forti Buratti, 2017)

that 31% of the participants do not have their images in any other support. Results also show how nearly three-fourths of the participants (78%) have more than one storage system.

The use of social networks as a place to store images is more common amongst the youngest, with 45% of the users between 18 and 24 years old versus none in the group over 65. Users with less than two years of experience trust cloud services less than the rest of the groups to store their images, as seen in Figure 23.

Concerning the use of the cloud to store images, DROPBOX is the most used cloud service for photos with 38% of the users, followed by GOOGLE and ICLOUD, as we can see in Figure 24 This leadership of DROPBOX is maintained through all the experience levels except for the most experienced users, who trust GOOGLE services more. More than one-third of the participants (37%) use more than one cloud service.

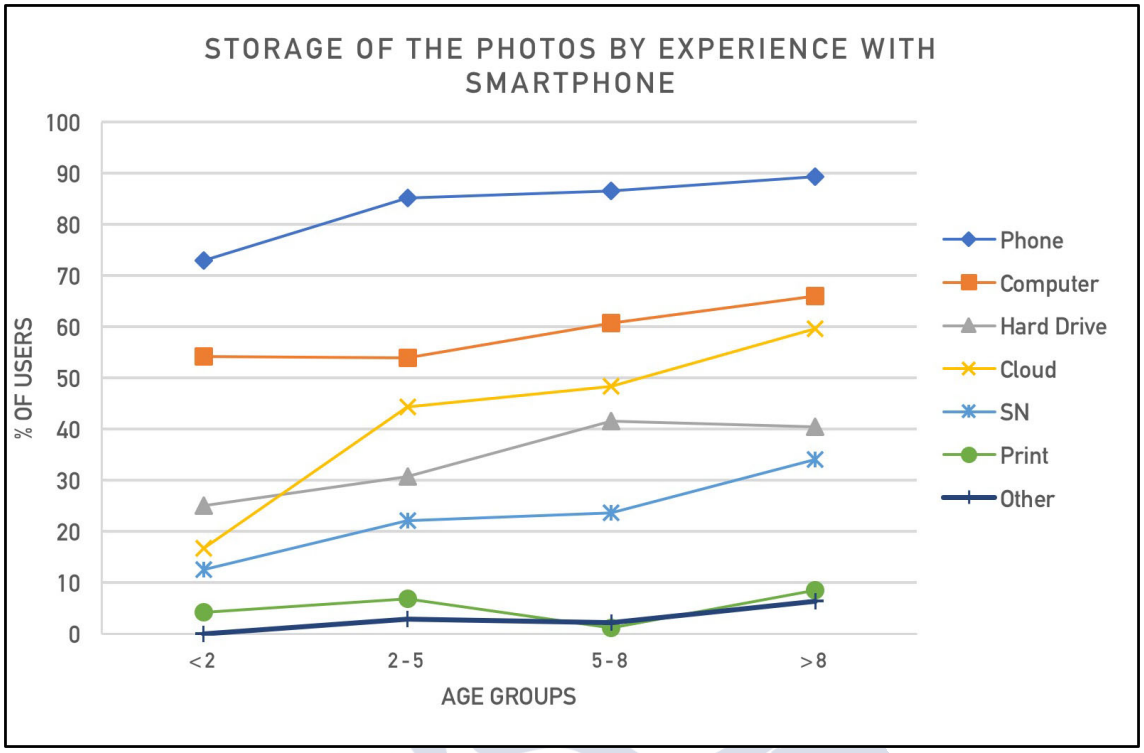


Figure 23: Storage of photos by experience with a smartphone. (CC Andrés Fraga)

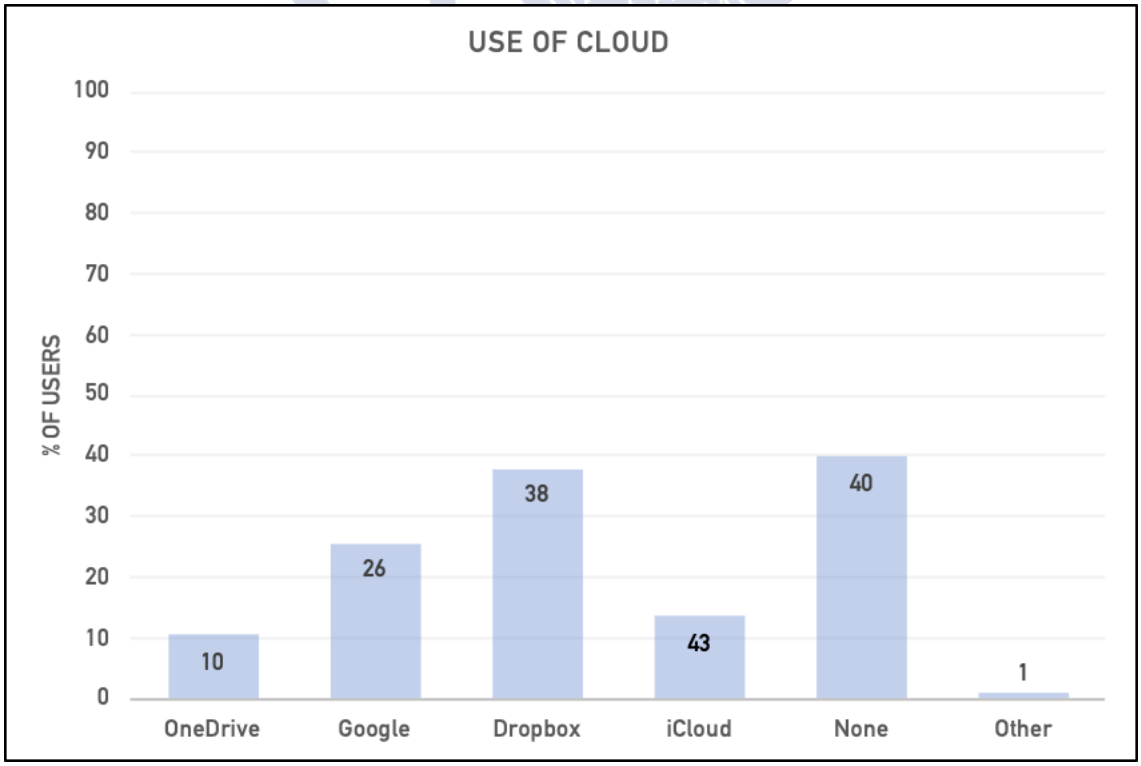


Figure 24: Use of Cloud. (Reproduce from Figure 4 in Fraga & Forti Buratti, 2017)

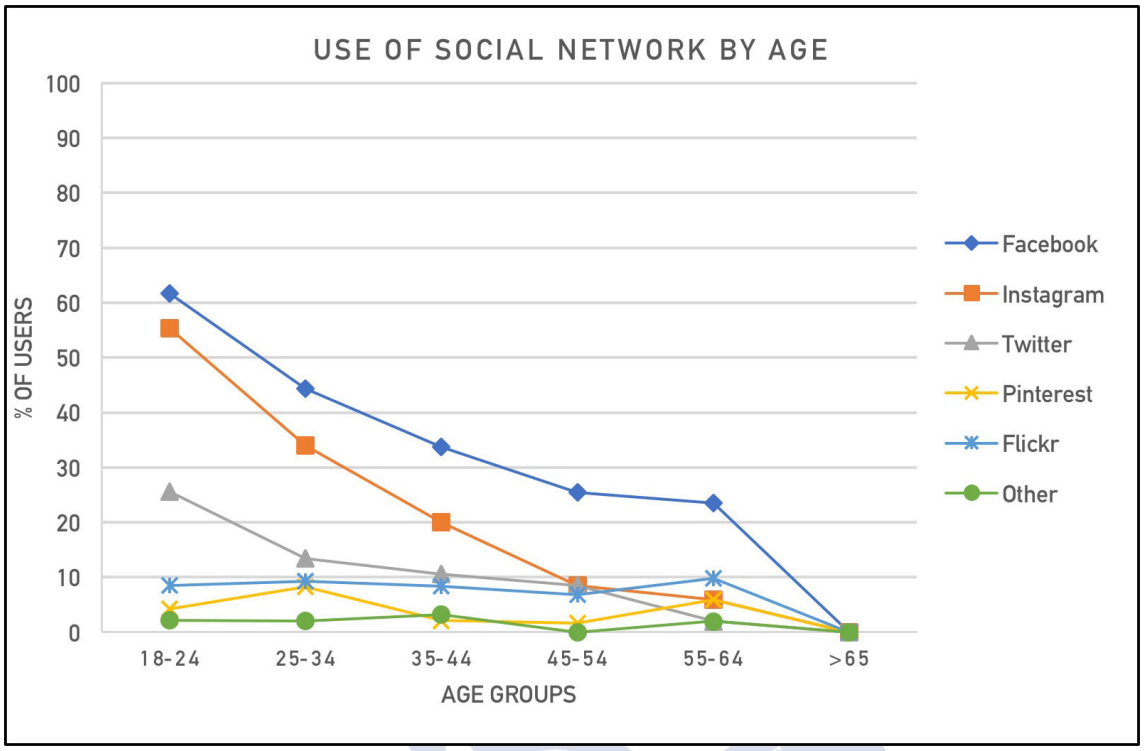


Figure 25: Use of social networks by age. (Reproduce from Figure 4 in Fraga & Forti Buratti, 2017)

Focusing on the use of Social Networks to store photos it is remarkable how this use decreases with age, except for FLICKR and Pinterest that have very similar use amongst all the age gaps, as seen in Figure 25, being FACEBOOK the most common social network people use to store their photos. At the same time, new users trust mainly Facebook and Instagram and try other social networks less. More experienced users have a wider variety of Social Networks, including traditional photo platforms like FLICKR.

When confronted with the situation of having to store a specific favourite image securely, 76% of the users save it in a computer. Quite far away is Print, the second option, used by 28% of the users, followed by social networks with 19%. Concerning age, Figure 26, young people trust social networks, while people older than 55 trust the computer. Concerning printing, 20% (p= 0.000) more women print their favourite pictures than men.

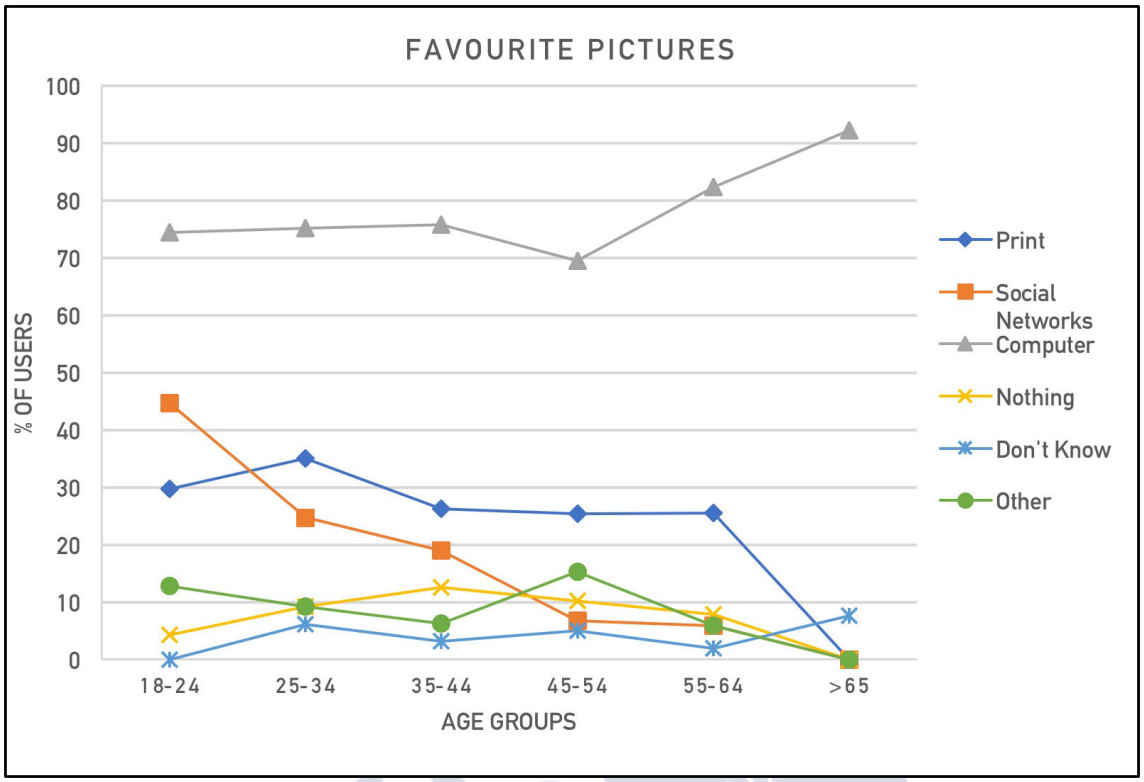


Figure 26: Favourite pictures by age groups. (Reproduce from Figure 9 in Fraga & Forti Buratti, 2017)

Finally, 89% of the users have watched at least once the photos they have taken with their phone. There is no significant difference among the different groups of age, experience with a smartphone, gender or paternity of small children.

2.4.3. Photo Album

The use of albums shows one of the most visible results of the review, where 59% of the users state they do not make physical photo albums anymore. As shown in Figure 27, there is also 16% that create a physical photo album but does not use their smartphone images. That leaves us with a total of 75% of the users that are not doing any physical album with their smartphone images. If we take the groups "No" and "No mobile" groups together and we compare the results with those of users with children under 18 years old and with those with no children, we see how there is a significant difference of 21 points, being the users with children under 18 years old more prone to do a physical album.

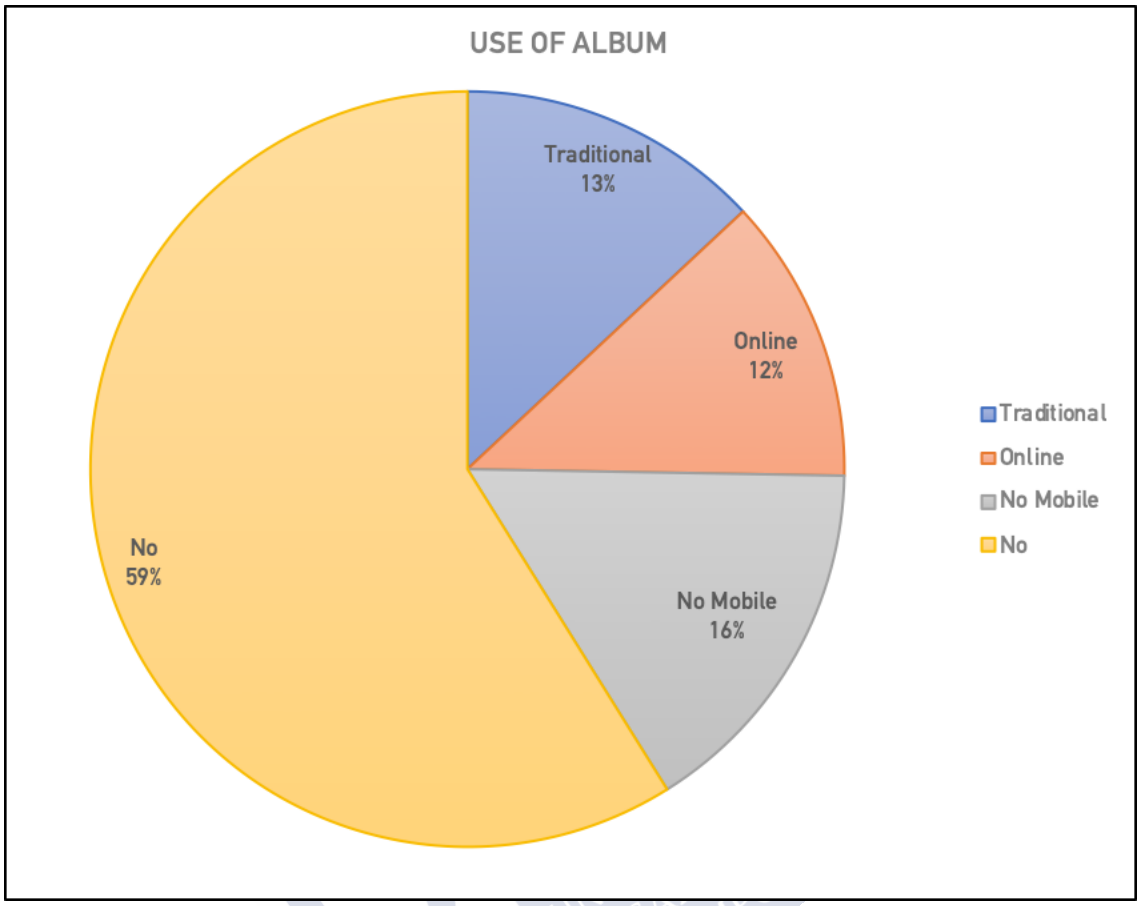


Figure 27: Use of Album. (CC Andrés Fraga)

When asked if they thought they would be able to watch the pictures taken with their phones in the future, 54% of the participants think that most of the pictures in their phones will probably get lost. Moreover, only a small percentage of them (8%) think that those photos are irrelevant. In this subject, the experience is an essential factor. In Figure 28 it is possible to see how only 19% of the users with less than two years of experience think they will be able to check their pictures in the long term while, among the users with more than eight years of experience, the percentage increases to 39%.

If we consider separately the group expecting their smartphones pictures to get lost from the rest of the interviewees, we found that there are no significant differences between them, except for one exception: all the users who have stated to create physical albums but not to take smartphone pictures consider their smartphone images will get lost.

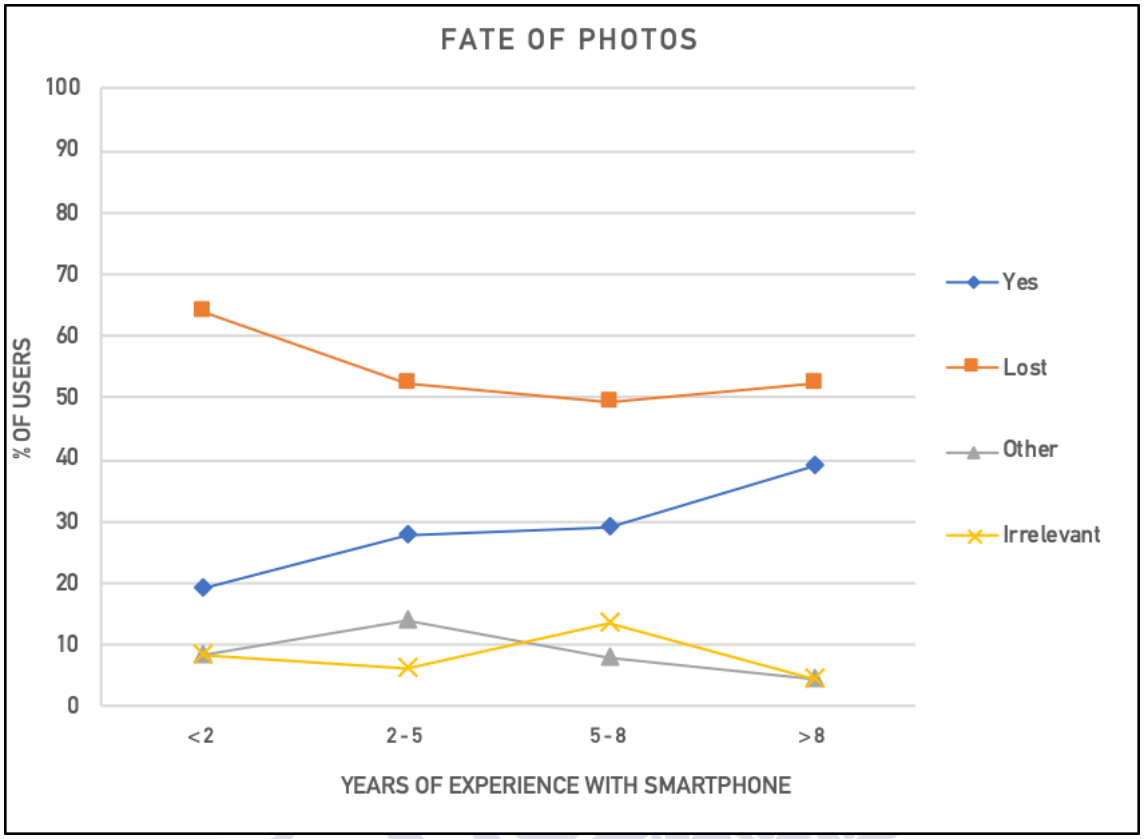


Figure 28: Fate of photos by years of experience with smartphone. (CC Andrés Fraga)

2.5. DISCUSSION

Focusing first on camera use, we found that all the uses cases of the camera we have proposed have been chosen by at least 60% of the participants, with one-third of the participants using all the uses cases in the survey. This situation reinforces our hypothesis that people take pictures outside the classic events. Situations like taking notes of a WI-FI password or sending a picture of the surrounding building to help a friend find the user's position are images that are entirely out of what we could consider an event. At the same time, these two same examples of uses are new and specific of mobile photography. We have also noticed how people with less experience with a smartphone keep using their phone camera as a regular camera, following the traditional habits of users of a domestic camera and focusing more on special events that on new usages. Since nowadays people are always carrying a camera, they are more likely to document moments outside those

Figure 29: Image taken to take note of the wi-fi password in a home router. (CC Andrés Fraga)

special events that were traditionally documented and to introduce new habits for their camera use.

The adoption of a smartphone camera as a tool to share moments with absent friends and family (46%) and to talk to friends and family (42%) in users with less than two years of experience is relatively low. In contrast, the fast adoption of instant message apps like WHATSAPP (79%) reinforce the idea that users adapt faster to new technological habits than to new photographic habits, as they start earlier to share their existing images, probably from some special events, than to make new images that are specific to share on instant messages apps.

That ability to adapt to new apps is shown in the behaviour with social networks, as new users of smartphones are more likely to use the trendiest social networks to store their images, while the users with more experience keep using “old” social networks

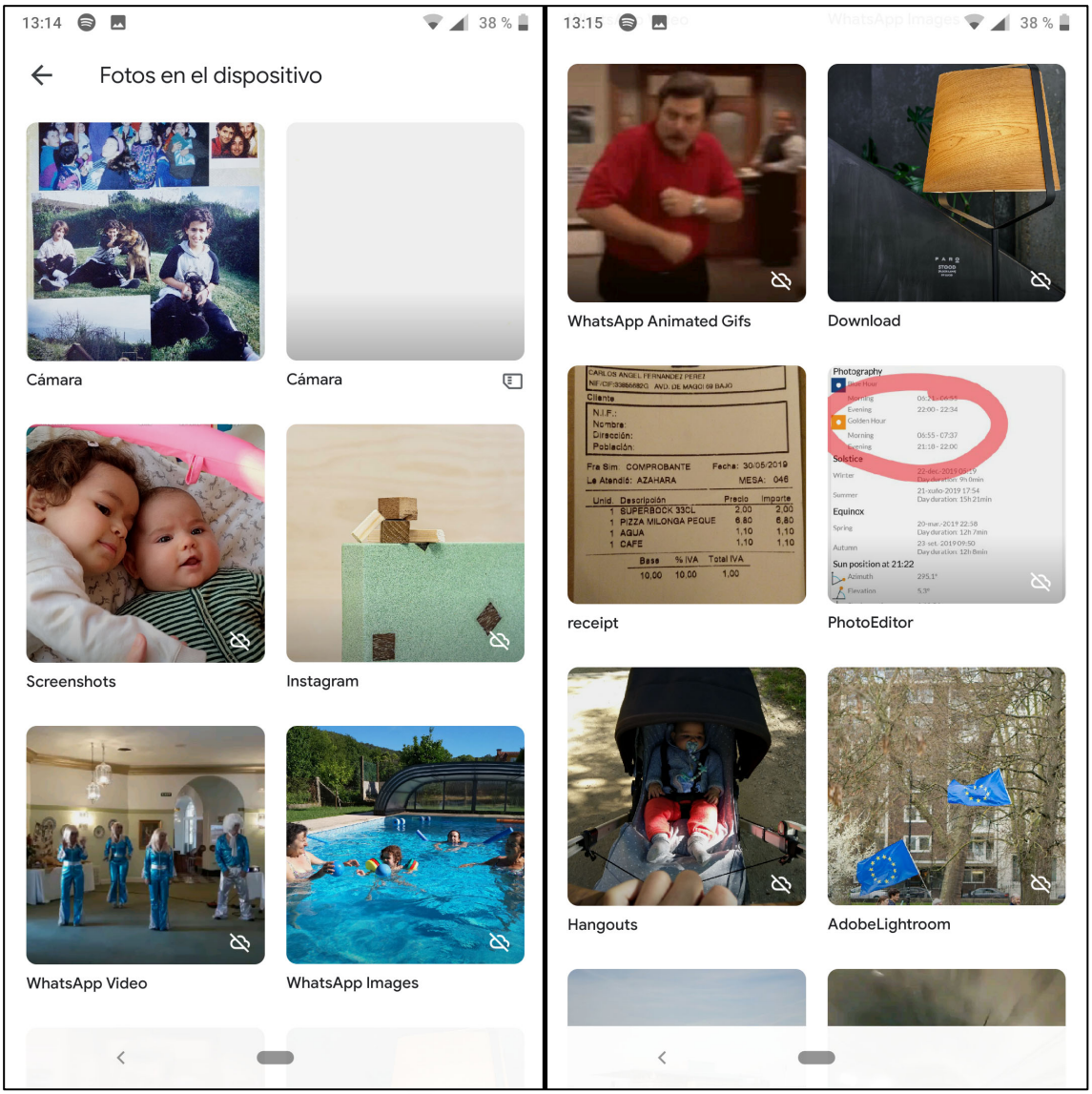


Figure 30: Screenshots of Google Photos app on Android show an example of the many different folder with images in a user smartphone. (CC Andrés Fraga. Screenshot of the software installed on an Android phone)

while joining the new ones. It is important to remember that users with more than eight years of experience with smartphones, could be considered early adopters (Chesbrough & Crowther, 2006), so they are more open to try different services, as it was again shown in the number of storage systems they have.

It has been proved that the camera is not the only way people introduce pictures on their smartphones, as only 5% of the participants state they have only pictures from their

camera. The increasing popularity of instant message apps like WHATSAPP means that most of the users will have images from, at least, those two sources. In Figure 30 it is possible to see an example of the many image sources represented in the different folders created by every different app to manage images. Instant message apps also open the door to the staggering number of authors of those images, as it is going to be discussed in further lines.

Screenshot revealed to be a popular tool for users between 18 and 24 years old, but it decreases rapidly with age, in a similar way to what happens with social networks. The high percentage of young users that capture screenshots show how an image source that has no relationship with the camera can become frequent, adding a new typology of images to the same image flow. We consider this result to be highly interesting and we believe that further research should be conducted on the use of these new image typologies.

The fact that most of the users have pictures that they have not taken creates a new variable to image management that most of the systems do not have, as they are based mainly on date and location. AI processing can add information about objects and people in the image, but not about the person who took the picture in the first place. Together with the popularisation of instant message apps, this creates a very different photo management scenario from that with consumer digital cameras, where users only have to manage their own images (Whittaker et al, 2009).

The computer is, after smartphones, the most common place to store the images taken with the mobile phone and it holds this position through all the ages and years of experience. Confronting this situation with Evans's (2015) predictions, which state that in 2020 there will be five times more smartphone users than domestic PCs, could lead to a situation where users will lose one of their most trusted and usual devices to store their images. This will force them to adapt their photo management habits to a new mobile-only situation, but they will also confront the problem of how to review the past images stored on computers and external drives.

As users gain experience, they start to trust safer services to store their photos and rely less on traditional solutions like printing them. This tendency points to the cloud as the most suitable tool to work as a bridge between computer-based photo management and mobile-based photo management.

Despite this fact, more than half of the users that have their photos stored in the cloud also have a copy on their computers. If we count computer and hard drive, only 31% of the users that have a copy of their photos on a cloud service do not have a local copy. That could lead us to believe that there is still a lack of confidence or knowledge from smartphone users on the different cloud services that the leading technology companies are offering. All Microsoft, GOOGLE, AMAZON and APPLE offer easy ways to automatically upload the user's images directly from the phone to their clouds and all those services were active at the time this survey was conducted.

It is essential to mention that cloud is not guarantee per se of long-time storage. Many photo storages services have closed, leaving their users without access to their services and metadata related to those images in some cases, and even without the images in others. In July 2016 an article in The Wall Street Journal cited Lyve, a service that stores the images in a local hard-drive but gives access to them through an online platform, as an interesting alternative to store consumer photos (Olivarez-Giles, 2016). Three months later Lyve announces to their users that the service was about to disappear and was shut down in December 2016.

The fact that half of the participants in the survey have at least four different usages of their phone camera reflects how complicated the photo management on mobile phones is. Users have many different uses for the camera and that creates different kinds of images that are going to be used in different ways and through different channels.

Moreover, it happens the same if we analyse the rest of the topics studied in this research. In the case of the image source, we found that 75% of the users have at least three different sources for their images. Most of them have photos they took together with pictures from their family and friends and those images are generally stored in at least two different places. This level of complexity requires mobile photo management to be

much more comprehensive than previous digital photo management, where the source, authorship and storage method used to be unique.

This complexity also reaches the new methods of storage, as more than one-third of the participants use more than one cloud service. At the same time, regarding social networks, it is possible to see how, the more experience the user has, the wider range of Social Networks they use.

That means that photo management should go further than just organising the pictures taken with the camera, because, independently of the number of images that arrive at the mobile phone, it is clear here that there are many channels for the images to reach the phone. Therefore, unlike in the case of storage safety, which improves with the experience of the user, the complexity of the systems does not seem to improve with the years the user spends with a smartphone. The results show that in most of the storage systems, there is slow progress in the number of services related to the years of experience.

This leads us to a situation where all the views we have applied in this study show a high level of complexity, with many different results and with different consequences when comparing the other variables such us age, gender, experience and paternity of young children. In Figure 31 it is possible to see how, except for Cloud Use and Social Networks, the average of choices that users have is two or more. This complexity improves as the users get older but it shows a very complicated scenario concerning users under 65 years old.

In contrast with the hypothesis of this study, the results show how users do watch their images on their phone. This habit implies that photo management systems must keep images safe and at the same time, allow users to review their images quickly.

Pushing the participants to the situation of choosing what to do with an image of particular value forces them to perform a manual action that shows their preferences. In that case, most of the participants chose a conservative approach, choosing the computer

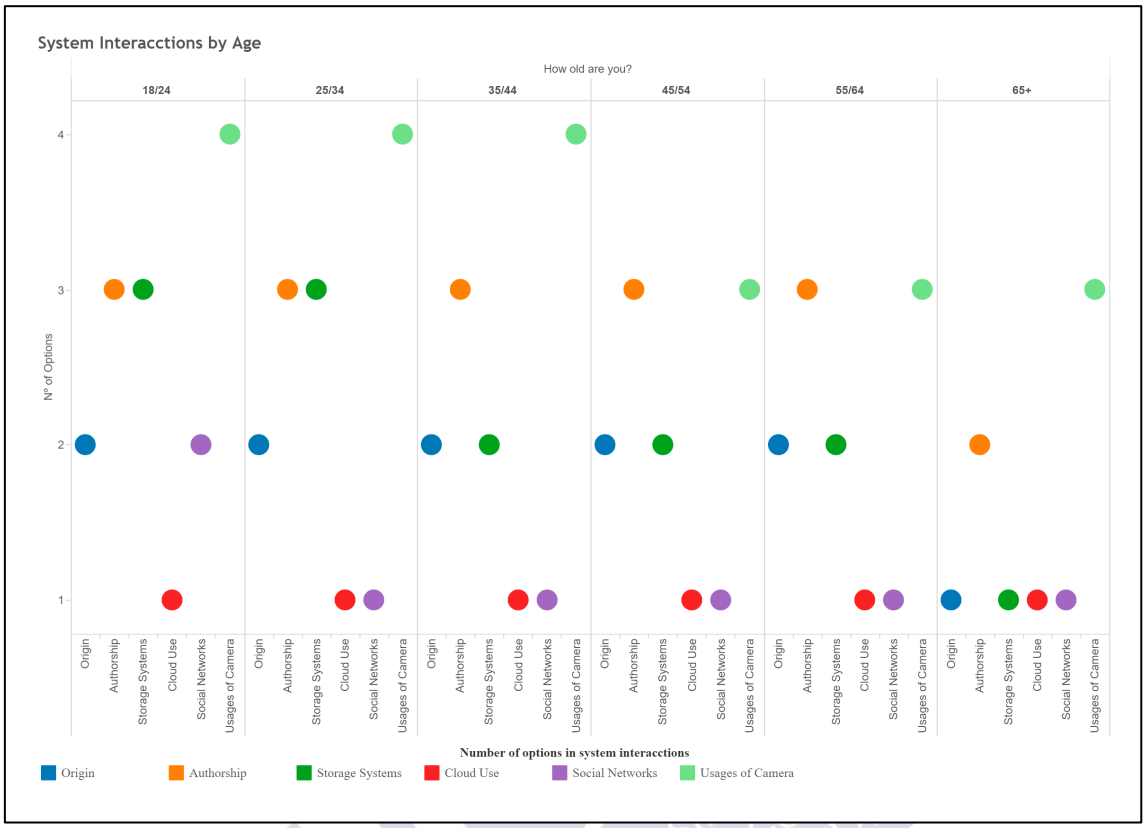


Figure 31: Complexity of mobile photo management. (CC Andrés Fraga. Figure created using Tableau Public)

as the best place to keep their most significant images. Comparing these results with Evans's (2015) predictions, our result predicts an even worst scenario, where users will not be able to access their most valuable images. This landscape could help to understand why the second option, chosen by more than one-fourth of the participants is printing them, leaving smartphone users with a hundred-year-old solution to a brand-new problem.

Concerning the use of an album, the results go in a similar direction. We found that 59% of total surveyees do not create any printed album with their personal photos. This value increases up to three-quarters of total if we add the users that do some printed album but do not use their smartphone photos. This group has a significant value, as it represents users that make the curation effort of selecting and printing the images needed for an album but leave out all the images created with smartphones. We have analysed this specific group in comparison with all the others and we have not detected significant

differences in any of the questions made. We did find some small differences regarding to what they would do with a favourite image, with the percentage of users that did not know what to do rising from 2% up to 6% in the case of users that did not used their smartphone photos for their printed albums. There is also a small difference concerning the future of their smartphone images, as they are more prone to think that those images will get lost.

The last question sought to find out if the users were aware of the situation they live in and the results show how only 28% are confident of being able to see their mobile phone pictures in the future, supporting the idea of frustration that is so present in previous studies (Whittaker et al, 2009; Miller & Edwards, 2007; Frohlich et al, 2002). It is also visible how new users trust less their smartphones as long-term use devices. This might have a relation with the lack of use of safe storage systems and the unfamiliarity of some of the current tools to manage images.

This alarming last result, with such low trust in the systems they are using, shows no significant relation with the use of clouds. The only other relevant difference is not using their smartphone pictures for printed albums, but this could be a consequence of the lack of tools more than a deliberate decision. Further research would be needed in order to understand the reasons behind this frustration.

2.6. CONCLUSIONS IN SMARTPHONES PHOTO MANAGEMENT

The ubiquity of the smartphone camera allows new ways for using photography. Users adapt their photo habits to the new possibilities as they gain experience with the smartphone use. This experience opens possibilities for them, but it also creates a more sophisticated photo infrastructure. This complexity is reflected in all the aspects handled in this research, with an increasing variety of typologies, sources and authorship in snapshot photography.

The specific case of authorship of images requires more in-depth research, as the increasing popularity of instant messaging apps is set to increment this variety and current photo management software is not designed to deal with this new variable.

Most users have not yet discovered the advantages that the use of the cloud can have in the management and safety of their images. Both the use and the trust in cloud services should improve to allow a smooth and non-traumatic transition from computer-based digital photography to a mobile-only system.

Most of the users do not use any printed album for their smartphone's pictures, relying exclusively on digital solutions for the long-term conservation of their snapshots.

The lack of confidence that users have in current systems to work as photo archives in the long term does not act as a deterrent to use new apps and social networks, but it generates frustration.

CHAPTER 3 CURRENT SOLUTIONS TO MOBILE PHOTO MANAGEMENT

3.1. FROM BACKUP TO REMEMBERING

When Sarvas and Frohlich (2011) adopted the concept of infrastructure, they did it to talk about the change that the arrival of digital photography entails to snapshots users. Film users only needed a camera and a trip to their nearest photo store to buy a new film and develop the one it was already exposed. The arrival of digital photography meant that the user started to assume part of the functions they were used to delegate on professionals before. This function implies a set of new hardware and software, cables, protocol, drives, printers and new files. This change of elements involved in the domestic photo management is what they call the change from a film-based infrastructure to an ICT infrastructure. With mobile phones, we could argue that the concept of infrastructure has disappeared, at least from the hardware point of view. Smartphone has become the only tool to create, edit, share, display and store all personal photos. Obviously, users can still use other software and hardware to do it, but for the snapshot user, there is no need. Despite this fact, we believe we can still talk about infrastructure. There has been a unification of the hardware; users no longer need a pc, screen, cables, printer and modem. However, there is a massive universe of apps, cloud services, web services, social networks and OS that create a complicated enough infrastructure, as we have seen in the previous chapter.

When looking at KODAK and their business model, it is correct to affirm that it had some exceptionality. For more than a century, KODAK business model worked around a single principle: sell film and all the necessary infrastructure to get the pictures back. This model created what Sarvas called a big ecosystem, an infrastructure owned by a single company. Today, those ecosystems are GOOGLE, Microsoft, APPLE and AMAZON and they all compete with each other offering equal or very similar services, being snapshots photo-management one. However, in this competition to offer the best tool and service to people's needs for photo management, underlays their wish to obtain the most contextual information they can. This is because their business model relies on the value of the metadata (Sarvas, 2014). However, regardless of whether they do this to commercialise their metadata, or to fix user to their paid platforms, they need to offer a solution that can fulfil users' needs in photo management.

Trying to unify all previous functionalities that photographic ecosystems have into one unique hardware, the smartphone, requires a level of complexity that occasionally exceeds the simplicity expected by users. Furthermore, ecosystems must deal with many different actors with different, and in cases, conflicting interests. One example was the photo management in Windows Phone 8 shown in Figure 32. that offered many possibilities for developers to integrate their apps in the photo-flow but failed to integrate this use in the user's experience (Fraga, 2013).

This constant competition in innovation has dragged most users to a constant change in their habits and routines in order to keep their photos organised. They must adopt new technologies and services that, on some occasions, have a very short life expectancy. Some of the apps we have studied in this research, like CAROUSEL, have disappeared in the five years spam of this investigation. Other apps like Togthera (Toghethera, 2016) or Shoebox (Shoebox App, 2019), that offered similar services, have also shot down in this lapse of time. More relevant is the case of WINDOWS 10 Mobile. The mobile version of Windows OS, the most used desktop OS (Humphries, 2019), was supposed to consolidate MICROSOFT market domination in a moment when personal computer sales were way below smartphone sales (Evans, 2015).

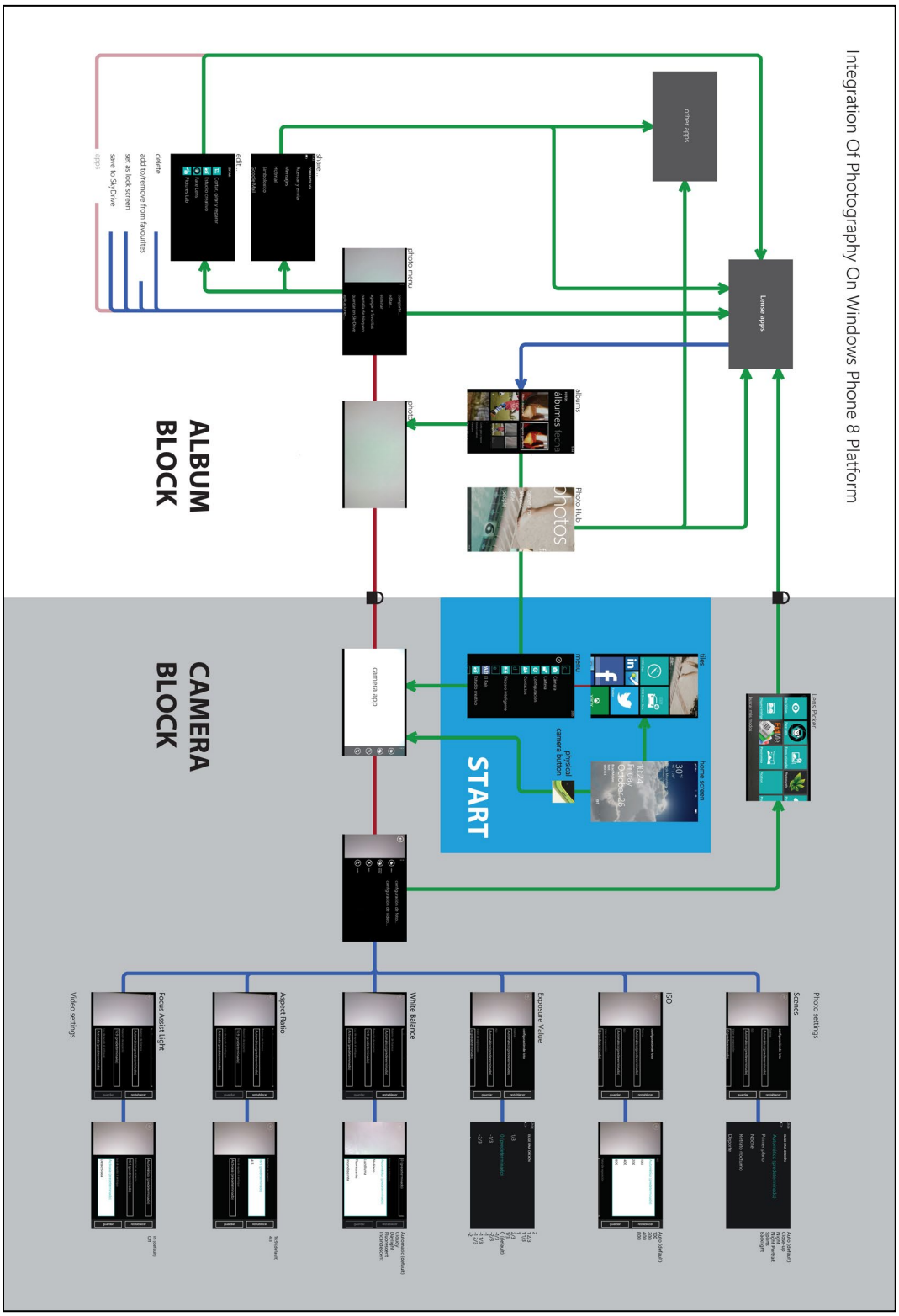


Figure 32: Diagram of Windows Phone 8 image management. (From annexes at Fraga, 2013)

MICROSOFT even bought the mobile division of NOKIA after the rumours that NOKIA might change their actual Windows Phone OS to ANDROID (Warrem, 2015). Despite this fact, MICROSOFT has announced that they have stopped the developing of WINDOWS 10 Mobile, the current versions of Windows Mobile. Those examples of services, both from respectful and well-known big companies as well as from small start-ups, show the volatility of the current photo management services. Those two cases are a clear example of how important it is to have a clear view of what photo management services are currently doing and offering with the user's images and, therefore, memories. The recent ban of the Chinese manufacture Huawei in the United States of America might cause their global users to stop receiving updates in their GOOGLE apps and other consequences that are still to be clear (Brandom, 2019). Again, this is only a demonstration of how fragile some big companies can be.

3.2. SYSTEM ANALYSIS

Previous studies on domestic photo management were oriented mainly from the user's point of view and had the semi-structured interviews with a selected group of users as their central methodology. Works like Richard's Chalfen (1987) *Snapshots versions of Life* set up the foundations of this methodology that has been broadly used in works by Odom, Frohlich, Miller (Odom, et al., 2013; Frohlich et al, 2002; Miller & Edwards, 2007).

We choose the term “system” to englobe apps and OS features as well as the related clouds and web services. As different companies offer different ways to manage images, a more extended term like system help us to focus the investigation without leaving possible solutions out of our reach.

System	Google Photos
Do they sync all the photos on the device?	Everything that is in the Photos app
Can they be automatically downloaded to a computer?	Can sync with desktop app to a computer. The user previously has to "Add you Google Photos to My Drive" so that they will sync with the computer.
Do they auto update to a cloud?	Only if app is open
Can the user create collections / Albums? Manually or auto?	It can create automatic Stories, Movies and Albums, but not always and not with all the images. The user can create Stories, Movies and Albums manually from the Assistant tab.
Does it have different views?	It has 3 main blocks: Assistant, Photos and Collections. Assistant shows the pending upload and, in some cases, if the app has generated some automatic effect on photos or composition. In Photos, a general view with a summary of the images taken in every month is given with a clear label of every month and year, if the user zooms with the fingers, it is possible to observe all the images organised by months. More zoom results in a view by day. Every time the scroll is used, a fast scroll button shows in the right side to move fast along the whole collection. Going to the single image view, the option to share and edit is given, with some manual and auto adjusts as well as filters and cropping options, with some Exif info from the camera and a location shown on a map. A description can be added here. In Collection, Albums, Movies and Stories are shown and it permits to choose to see all of those kinds together or one of them separately. In every moment of the main blocks there's a button to access Search. In Search it shows a space to effectuate a search and collections organised by labels, making difference in Places and Things
Can photos be printed from the app?	Yes, from the share option with AirPrint
Can tags or keywords be used? Does it do it automatically?	Yes, it creates automatic tags based on the image content and metadata. It organises the tags on Places and Things. Tags or any other element that can represent the image like objects on it, events, places near, can be searched. It is possible to edit, create or delete tags, and add a description, but this is not searchable.
Can the pictures be shown on a TV screen?	Yes, via Chromecast
Does it have a maps view?	In the Info view there is a map with no zoom options
Other comments	
Version	1.5.0 - 12/11/2015

Table 5: Example of the record card used to collect data from systems. In this case is Google Photos working over iOS.

To understand the current solutions to photo management, we decided to create a questionnaire to "ask" the different systems used in smartphones if they could fulfil some previously chosen tasks. With updated data on how users are using their phones, we studied how photo management systems face those habits and how those systems have evolved over two years. In Table 5. it is possible to see an example of the record card used to collect the data about systems features.

Software development on mobile platforms is a fast-changing world. Trying to take a fixed image of the current situation would limit the usefulness of the results of this study. We also believe that to be aligned with the long-term objectives of photo management, the studies should focus more on the trends and the evolution of the current solutions

For that reason, the study was organised in two periods separated by twenty months. In each of those periods, the chosen apps and services were subjected to a test where they were asked a series of questions to observe if they could perform specific tasks or how they organised some of their processes. These questions were asked to all the apps and systems studied in all the OS where they were available. The questions were mainly chosen with the results of Chapter 2 in mind.

3.2.1. Systems selection

By looking at the current distribution of platforms on the smartphone industry, it is easy to state that it is mainly a two-player game, with ANDROID having 85% and IOS 14,7% of the global smartphone market in 2017Q1 (IDC, 2018).

The decision to work with those two operating systems and their platforms was evident as together they comprise more than 99% of the smartphone market. Nevertheless, as the main idea of this work was to understand how the systems are dealing with the problems of the users, we decided to include the third most used platform, WINDOWS 10 MOBILE, as it can bring new solutions and approaches that can enrich the results, despite their little relevance in current markets. Even though at the beginning of

Company	Operating System	Service	Associated Cloud	Android	iOs	Windows 10 Mobile
Apple	iOS	Photos	iCloud	X	✓	X
Microsoft	Windows 10 Mobile	OneDrive	OneDrive	✓	✓	✓
Google	Android	Google Photos	Drive	✓	✓	X
Dropbox	-	Carousel /Dropbox	Dropbox	✓	✓	✓
SmugMug	-	Flickr	-	✓	✓	✓
Amazon	-	Amazon Photos /Prime Photos	Amazon Drive	✓	✓	X

Table 6: Systems analysis on the research and their relative services as well as their presence in the mobiles OS.

this research MICROSOFT mobile OS was a growing platform in the market, at the end of it WINDOWS 10 Mobile market share is less 0,1%, and MICROSOFT has announced that they are not focused on the future development of their OS (Warren, 2017). WINDOWS 10 platform was the first platform that aimed to unify the desktop and mobile experiences, offering different versions of the same operating system under a real unified platform for users and programmers (Popper, 2015).

Based on the results in the previous chapter, six systems were chosen: those having both specific apps for mobile devices and a cloud-based online service. As it is shown in Table 6, we have chosen the photo managing solutions of the three leading mobile OS companies, being Photos from APPLE, ONEDRIVE from MICROSOFT and GOOGLE PHOTOS from GOOGLE. Although they are not operative systems, DROPBOX and AMAZON were also included, as they have cloud services that include specific photo management tools.

FLICKR was also included, as it is a photo-oriented social network that offers the possibility of managing a personal photo collection and used to offer 1TB of free storage for photos.

We have used the official apps for every system in every available platform. GOOGLE PHOTOS, ICLOUD, AMAZON and FLICKR do not have apps for WINDOWS 10 Mobile platform, but in the case of FLICKR, it was decided to analyse a third-party app that has a very similar user experience to the FLICKR app in other platforms. A similar case happened with CAROUSEL, as it did not have an app for WINDOWS 10. Users of DROPBOX had used the proprietary app of DROPBOX, but they lost most of the user experience and services that CAROUSEL web service and app had in other platforms.

The first sampling was made in November 2015 using an IPHONE 5 with IOS 9, a BQ Aquaris A4.5 with ANDROID 6 and a MICROSOFT Lumia 950 with WINDOWS 10. The second sample was made in June 2017 and the hardware used was an IPHONE 6s with IOS 10, a Nexus 5X with ANDROID 7 and MICROSOFT Lumia 640 XL with WINDOWS 10. Due to the constant evolution of the app market, some of the applications experienced significant changes during the nearly two-year process of the study. CAROUSEL app no longer exists and DROPBOX has unified its photo and files management in a single app and web service. AMAZON has changed the name of its photo app from AMAZON PHOTOS to PRIME PHOTOS.

One issue that we must consider is that those systems do not work in the same way in every country. Business strategies and legislation limitations implicate that some of the services we have analysed here might have more, less o different features in other countries. On the basis that this study was made in Spain, using Spanish accounts on all the application stores and services, we have tried to analyse the main features even if some of them might not be accessible in Spanish territory. Some of the AMAZON Prime photo services, for example, are not accessible in the same way depending on which country the user has their account.

	OS	Do they sync all the photos on the device?	Can they be automatically download to a computer?	Do they auto update to a cloud?	Can you create collections / Albums? Manually or auto?	Does it have different views?	Can you print photos from the app?	Can you use tags or keywords? Does it do it automatically?	Can the pictures be shown on a TV?	Does it have a maps view?	Other coments	Version
iOS9	One Drive	YES	YES	YES	AUTO	Years, Collection and Moments	YES	No	Only via Apple TV	YES	The Gallery of the phone and the iCloud service are in the same app.	9.1 (1383143) / 12/11/2015
	Google Photos	YES	YES	NO	MANUAL	All Photos, Albums and Tags	No	YES		No	There is not an specific app for the photos, is the same app for photos and the rest of the files on the cloud, eventhou it has his on space.	6.1.1 / 12/11/2015
	Carousel	YES	YES	NO	AUTO	Assistant, Photos and Collections	YES	YES		YES		1.5.0 / 12/11/2015
	iCloud	YES	YES	YES	MANUAL	Timeline, Album, Flashback and Shared	No	No		No	Offers to free the space on the phone by deleting the images it has allready upload.	1.14.1 / 12/11/2015
	Flickr	YES	NO	YES	AUTO	Same as in OS	YES	YES	Same as in OS	YES		
	Amazon	YES	NO	NO	MANUAL	Camera Roll, Public view and Albums	No	YES		YES	Quite slow syncing	4.0.6 / 12/11/2015
					MANUAL	All, Albums, This Day and Folders	YES	No		YES		3.7.1.182 / 19/11/2015
Android 6	OS	There's no gallery app any more in version 6. Gallery only works for										Android 6.0 on BQ Aquaris A4.5 2.2.0-20160201-1650
	One Drive	YES	YES	YES	MANUAL	All Photos, Albums and Tag	NO	YES	Yes via Chromecast	NO	Pictures taken with Whatsapp are not saved. You can search for more tags than the ones he shows.	OneDrive 3.8
	Google Photos	YES	YES	YES	AUTO	Assistant, Photos and Collections	YES	YES	Yes via Chromecast	YES		Buil Version 1.13.0.113885202
	Carousel	YES	YES	YES	MANUAL	Timeline, Album, Flashback and Shared	NO	NO	NO	NO	Pictures taken with Whatsapp are not saved. You can select an app by pushing up in the fullscreen mode.	Carrousel Version 1.15.3
	iCloud											
	Flickr	YES	NO	YES	MANUAL	Camera Roll, Public view and Albums	NO	YES	NO	YES	Pictures taken with Whatsapp are not saved.	Flickr 4.0.7 (45549)
	Amazon	YES	YES	YES	MANUAL	All, Albums, This Day and Folders	YES	NO	NO	NO	Great option to creat Albums from folders	Version 5.0.2214801qt
Windows 10	OS	NO	YES	YES	MANUAL	Collection, Album and Folder	No	No		YES		Microsoftp Photos 15.1111.12232.0 / Windows 10 Mobile 1511 OS Build: 10.0.10586.11
	One Drive	NO	YES	YES	NO	All and Albums	No	No		No		OneDrive 17.4.1
	Google Photos											
	Carousel (Dropbox)	NO	YES	YES	MANUAL	Timeline	No	No		No		Dropbox 2.4.0.0
	iCloud										Only in desktop version	
	Flickr	NO	NO	NO	MANUAL	Photostream, Favourites and Albums	No	YES		YES	Xbox official app.	Flickr Central 3.6.1
	Amazon											

Figure 33: Table with the resume data collected on the first sampling. (CC Andrés Fraga)

We are aware that there are other solutions on the market that target the same problematic, but those services have minimal market penetration compared with the systems we have studied. Apps like 23Snaps, Lifecake or Clusteras, offer private albums and closed sharing groups but are far away from being complete solutions to mobile photo management.

3.3. DATA ANALYSIS

3.3.1. Syncing of all photos in the device

When analysing the results of the first sampling, it was found that some of the systems do not allow users to choose which images they want to synchronise, as shown in Table 7. In the case of IOS, as the operating systems unify all the photos in a single gallery, not allowing any app to create any new folders or store photos in a different place, all the apps tested automatically sync all the photos on the phone with their cloud services, in the same way APPLE does with ICLOUD.

In the case of ANDROID, the operating system does not force the apps to store all the photos in the same place, giving the apps more freedom to choose which folders they want to sync. ONEDRIVE only syncs the photos taken with the camera and CAROUSEL, the photos taken with the camera and some other sources such as FACEBOOK or screenshots. Both FLICKR and AMAZON PHOTOS, both sync all the photos found on the phone, regardless of whether they are from the camera, browser or downloaded from any other apps. The most comprehensive solution is the one that GOOGLE PHOTOS uses. The app searches for photos in all the folders but lets the user choose which folders he wants to sync. The app detects when a new folder with images is created and asks their users if they want to sync it. There is an option in the menu to manually choose which folders to sync.

All Photos	iOS 10	Android 7	Windows 10
Photos	YES		
One Drive	YES	*YES*	NO
Google Photos	YES	YES	
Dropbox	YES	NO	NO
Flickr	YES	YES	NO
Amazon	YES	YES	

Table 7: System access to all the images in the device. Italics mean there was a change from the first sample to the second.

In the case of WINDOWS 10 Mobile, the operating systems works in a similar way it does in ANDROID, allowing the apps to create folders to store their photos. Nevertheless, none of the apps tested in this operating system allowed a full copy of all the photos on the phone. WINDOWS 10 Mobile image gallery and ONEDRIVE service are integrated as part of the operating system, and even though they work similarly, they exist as two different apps. In this case, only some of the folders with photos are synced with ONEDRIVE, although they are inside the Photo folder. Pictures taken with the camera are stored in the *Camera Roll* folder and images saved from other apps are saved to the *Saved Pictures* folder, screenshots go to *Screenshots*. All contents of those folders are automatically synced with ONEDRIVE. The images saved in other folders, like *Sample Pictures* or any other folder that the user would have created, are not going to be synced. In our test, the images saved on the SD card were not synced. It is noticeable that it synced both jpeg and Raw files.

In the case of CAROUSEL, only the photos taken with the camera are automatically synced with the service, and there is no option to include more folders. FLICKR Central

Auto Update	iOS 10	Android 7	Windows 10
Photos	YES		
One Drive	NO	YES	YES
Google Photos	NO	YES	
Dropbox	NO	YES	YES
Flickr	NO	YES	NO
Amazon	NO	YES	

Table 8: Automatic sync of images to the cloud.

has the option of Auto Upload, although it only works when the smartphone is connected to a Wi-Fi network and when the phone is charging. In our test, we tried to proceed with the sync, but the sync service did not work during all the time we had the system installed.

In the second sample, the performances of IOS and Windows apps are nearly the same, but in the case of ANDROID, there are some differences. ONEDRIVE and PRIME PHOTOS (former AMAZON PHOTOS) now let the user choose which folder to sync, in the same way GOOGLE PHOTOS did, and notify the user if they have detected a new folder with images, in case they want to have it sync. As CAROUSEL has disappeared, now image upload is managed through the DROPBOX app, which does not allow the user choose which folders to sync.

Another point we checked was if the system was automatically syncing the images independently of whether the apps were open or not, as we can see in Table 8. In that sense, we noticed how in IOS only the operating system and their APPLE app Photos could do that. The rest of the apps must wait until the users open them to start syncing. On the

contrary, in ANDROID all the apps we analysed can automatically upload the photos to their cloud services in the background, without the need for any action by the user.

3.3.2. Automatic downloading to a computer

Most of the services analysed here offered the possibility of automatically downloading the stored images in their cloud services to a computer. In this case, this option is independent of the operating system used on the smartphone, as the interaction is exclusively between the cloud service and the user's computer. We understand this option is essential to analyse, as we say in the previous chapter, how more than half of the users still have their photos on a computer.

In the case of ICLOUD, it automatically downloads all the photos to any Mac or PC that has been approved to sync with that account. If it is a PC, the user must install a specific app to download those photos automatically. In the case of Mac, it does it through the Photos app. Original images are stored inside the Photo Library and are difficult to access by the user outside the Photos app. It is also difficult to locate the library outside the computer, for example in a externa hard drive or a domestic server or NAS.

In the case of GOOGLE PHOTOS, there is no specific app to download those images, but it is possible to do it with the option “Ad your GOOGLE PHOTOS to My Drive”. By doing this, all the photos stored in GOOGLE PHOTOS will be shown in the My Drive GOOGLE cloud service and they can be easily synced to any computer. The imagers will be organised by months and years within traditional folders. In July of 2019, GOOGLE announced the end of the connexion between GOOGLE PHOTOS and GOOGLE Drive as it was causing many confusions among their users (Welch, 2019). The disappearance of this integration left user without an automatic way of syncing their images to a PC. Despite this fact, users can still download their images in any moment form the account site on GOOGLE.

Auto Download PC	iOS 10	Android 7	Windows 10
Photos	YES		
One Drive	YES	YES	YES
Google Photos	YES	YES	
Dropbox	YES	YES	YES
Flickr	NO	NO	NO
Amazon	*YES*	YES	

Table 9: Possibility of automatically downloading the images to a computer. Bold fonts mean there was a change from the first sampling to the second.

DROPBOX works similarly. It has a specific software for many desktop operating systems that keeps a specific folder permanently synced with the cloud service. In that case, all the photos are organised in a folder without any subfolder division.

In the cases of FLICKR, in the first sampling, there was no proprietary app to sync the folders with the user's computer. There was a third-party app call PhotoSync that allowed to sync down FLICKR images to a PC but it is no longer supported. Users can still download their photos one by one, but the system is not comfortable or intuitive to download all their images.

AMAZON used to have a proprietary app for Windows and Mac but it is also no longer supported. In the second sample, AMAZON had integrated their photo management with their commercial cloud service AMAZON Drive, and now has a proprietary app that syncs both ways from and to a computer, in a similar way DROPBOX and ONEDRIVE does.

3.3.3. Photo visualisation and album creation

If we study how systems show the photos to the users, the most remarkable observation is that the UX of the apps are consistent trough platforms, keeping the concept of how they organise the information and how it is shown to the user and adapting it to the requirements of each of the operating systems. The difference is a bit bigger in the case of WINDOWS 10, as their design lines are differential. At the same time, the fundamental principle of all systems is to organise their photos in a timeline.

There are two primary ways to navigate through this timeline: by different views or by quick jumps. In the case of IOS PHOTOS and GOOGLE PHOTOS, the systems work in a quite similar way by letting the user "zoom" from a broader period (years) to a more specific one, like days. In the case of CAROUSEL and AMAZON PHOTOS, they keep all the photos in one single view, but they offer similar systems with a fast scroll with year and month milestones that allow jumping quickly from one date to another quickly. FLICKR offers a quick scroll, but without any milestone and ONEDRIVE does not have any solution of this kind.

In the second sample, the only noteworthy difference is that the DROPBOX app has now inherited CAROUSEL operation and ONEDRIVE also offers fast scroll. All the studied systems can create albums or collections, which are selections of photos that are independent of the date they were created. All of them offer the user the possibility to manually create albums with the selected photos as well as to edit them and to add and more photos. Photos and GOOGLE PHOTOS also automatically create a selection of photos.

In the case of IOS PHOTOS, this automatic selection is part of the timeline view, as it organises all the photos in the gallery inside "Collections", which are packages of specific dates and locations and a mix of both, and "Moments", organised by day. This kind of organisation is set up for all the pictures on the gallery and is the standard way of visualising the photos in the app.

Album Creation	iOS 10	Android 7	Windows 10
Photos	AUTO		
One Drive	AUTO/MANUAL	AUTO/MANUAL	YES
Google Photos	AUTO/MANUAL	AUTO/MANUAL	
Dropbox	*NO*	MANUAL	MANUAL
Flickr	MANUAL	MANUAL	NO
Amazon	MANUAL	MANUAL	

Table 10: Album creation. Italics mean there was a change from the first sampling to the second.

The IOS PHOTOS app also allows organising the pictures in albums, both manually and automatically. The app has some predefined folders for Favourites, Selfies, Panoramas, Videos, Screenshots and one call All Photos, where all photos on the phone are shown in a timeline but without being grouped. Manual albums can also be created.

On the other hand, GOOGLE PHOTOS used this automatic organisation differently. It keeps all the photos in the timeline, only divided by month and day, but when it detects some unusual activity (weekend trip, birthday) it creates an album with those images and it proposes it to the user. If the user accepts this proposal, the album will show up in the Albums tab.

GOOGLE PHOTOS, both in IOS and ANDROID, has as an "Assistant" tag, where the app will create an automatic selection of photos and propose them to the user. The "Assistant" tag, as seen in Figure 34 offers one of those selections to the user, who can accept it and

Figure 34: Google Photos Assistant tab. (CC Andrés Fraga. Screenshot of the software installed on an Android phone)

add it to the Collections tab or reject it. The automatic creation of those albums can be turned on and off by the user.

The rest of the systems offered manual ways to create albums or collections, by first selecting a group of photos and creating a new album with this selection or, as it happened in AMAZON PHOTOS, by creating a new album and then choosing the pictures to put in. They also allowed sharing new or existing albums with other users of the platform.

In the second sample, IOS PHOTOS has now a Share tab where shared albums can be created, but previous albums cannot be shared. GOOGLE PHOTOS now has an Albums tab with both shared and private albums as well as selections of People & Pets, Places and

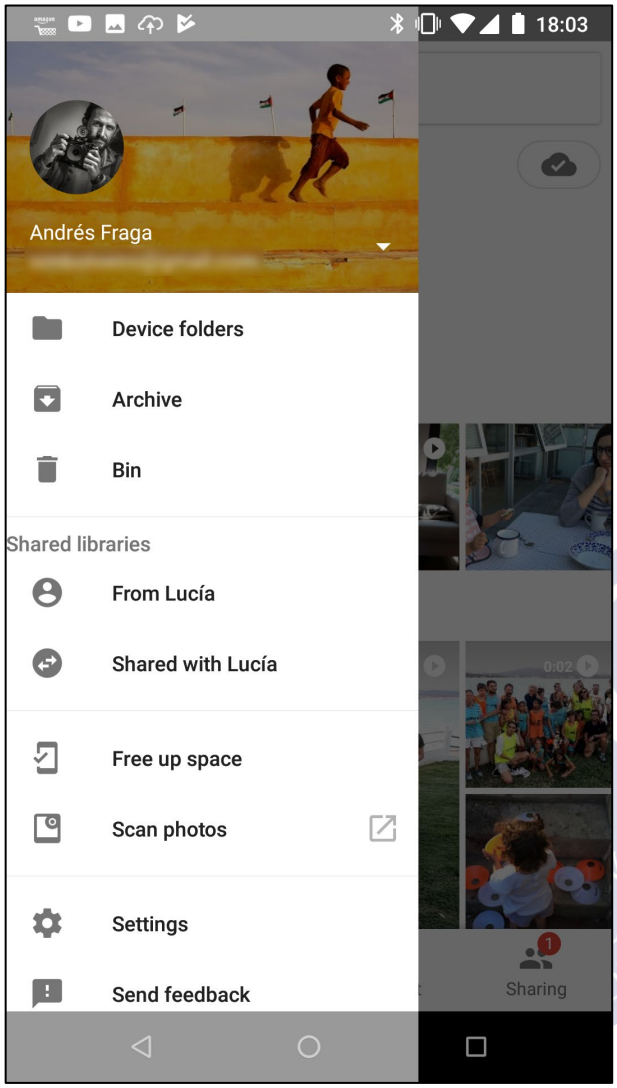


Figure 35: Google Photos menu where it is possible to see how, under *Shared libraries*, it allows to share and receive part of the gallery with another Google Photos user. (CC Andrés Fraga. Screenshot of the software installed on an Android phone)

Things. It has also added a Sharing tab with a timeline of users sharing activity as well as a small selection of photos together with another user that could be interesting to share with. It also allows to create new movies following a specific theme, such as pets, the growth of a child, a year summary and even to remember someone who passed away. GOOGLE has also added the possibility of sharing all the photos of the gallery with another GOOGLE user, as we show in Figure 35 . This option can be limited in time, sharing only photos taken after a specific day or by specific people, sharing only photos where some faces have been recognised. To do so, face recognition must be activated.

In the second sample, ONEDRIVE also creates automated photo albums based exclusively on date info. It collects photos from a specific day, or all the images created during a weekend. It does not make any selection for those albums, which means that it chooses all the photos of that day or that weekend.

CAROUSEL had a tab in his app call Flashback, where it showed the user some of the photos that were taken the same day in previous years. In the case that there were pictures taken in different years, it would show it to the user grouped by years. This feature, however, was not present in the second sample in the DROPBOX app, or in the photos section of the web service.

Both the app AMAZON PHOTOS and the web browser version have a similar service. There's a tab called “This Day” which shows the pictures taken in previous years organised by “Today,” where the pictures were taken the same day in previous years are shown, “Week”, which contains the photos taken in that same week in previous years and finally “Random Order”, which randomly chooses photos from other years. AMAZON PHOTOS also allowed the user to create albums directly from existing folders.

This feature of showing the user's past photos is still present in the second sample in PRIME PHOTOS, even though now the “This Day” tab has disappeared and will only show those past photos if the system has found old photos taken the same date the previous year. Surprisingly this feature is still available, as described early, on the web interface of PRIME PHOTOS.

GOOGLE PHOTOS and IOS PHOTOS added a similar service in the second sample. GOOGLE PHOTOS do it through the Assistant tab by creating a small collection of pictures taken one or more years ago. GOOGLE PHOTOS also creates collages which, for example, show a child and how he has changed in the last year, it gathers a selection of someone's best images in the last months or even fabricates small videos with a selection of someone's best photos over the last year.

3.3.4. Metadata: Tags or Keywords

Some of the analysed systems allowed to organise the user's photos by tags or keywords. In the case of ONEDRIVE, it has a tab called “Tags” where the images are automatically organised in collections by tags. The service automatically creates general tags for the images such as “landscape”, “people” or “plants”. The service also recognises other tags that have been included by the user in other software, at least under the IPTC standard. In the first sample, users could not edit or add new tags, but that was fixed in the second sample.

In the case of FLICKR, it offered the possibility of adding and manually editing the tags. Surprisingly, FLICKR's web interface automatically adds tags to photos, and if the user checks an image in the web service, he might find that it has some automatically created tags, but if he checks this same photo in the mobile app, they are not visible. If he manually adds a tag to a photo in the app, this will be shown in the web service together with the existing ones. Unfortunately, the user cannot organise the photos by tags, because even if the tags are interactive, when the user clicks on one, it searches in all the public images in FLICKR with that tag. This has changed in the second sample, as now the search by tag separates the user's photos from the rest, allowing to perform accurate searches. Nevertheless, this only happens on the web service. Apps still working in the same way in all the OS.

The case of GOOGLE PHOTOS is slightly different. It does not allow the user to add tags to the images, but it organises some of the images in collections by people, places or things. The user cannot create new collections or edit the existing ones. It also offers a highly competitive search method (Krizhevsky, Sutskever, & E. Hinton, 2012; Mordvintsev, Olah, & Tyka, 2015) that allows the user to search through many other elements or events that can be found on a picture, such beach, dog, birthday or wedding as well as the people in the images that have been previously recognised. The results of the search are organised in days and they can be unfolded every day to show the entire collection of pictures taken that exact day. In the case of IOS PHOTOS, the user can search for places and dates but it does not create any tag.

Tag management	iOS 10	Android 7	Windows 10
Photos	NO		
One Drive	YES	YES	NO
Google Photos	NO	NO	
Dropbox	NO	NO	NO
Flickr	YES	YES	YES
Amazon	NO	NO	

Table 11: Tag management.

3.3.5. Other characteristics

We have also analysed if these systems offer the user the possibility of showing the geolocation information in a map. We found that in the case of the apps, there is no difference among platforms, apart from AMAZON PHOTOS app, that works differently on IOS and ANDROID.

In the case of IOS PHOTOS, both the app and the web service offer the possibility of consulting the location where a photo was taken if the image is georeferenced. Users can also review a map showing the location or locations of the pictures of one collection. GOOGLE PHOTOS, PRIME PHOTOS and FLICKR also offer a map view on the info tab of single photos. However, One Drive and DROPBOX do not offer any map views for a single photo or albums.

3.4. DISCUSSION

3.4.1. Speed in the evolution of the apps

Most of the apps have evolved considerably over the process of this research. In the year and a half between the two tests, we have seen how continuous updates have been changing some of the options and characteristics we have hereby mentioned and we have noticed that there has been a significant improvement in their features. At the same time, there is a noteworthy unification in the UX of the systems as they have been implementing some of the best working features of the others to the point that most of them now have many features in common.

One of the most remarkable examples of this fast evolution is the case of CAROUSEL (Figure 36). The CAROUSEL app was developed by DROPBOX to manage the photo content of the users of their cloud services. DROPBOX had already an app for both ANDROID, IOS and WINDOWS 10 Mobile, but the introduction of CAROUSEL aims not only to backup the images from the phones but also to manage them correctly and allow to revisit them straightforwardly.

CAROUSEL was introduced in April 2014, and even though it was not the first option in the app sphere to promise a solution to photo management, it had some attractive options that we can now see in other apps, like a fast scrolling with date info or the Flashback features to revisit the users' past photos (Josh, 2014). Even so, the number of users did not fulfil the expectations of DROPBOX and, in March 31th 2016, DROPBOX closed CAROUSEL and forced the users to go back into their previous DROPBOX app. Some of the features presented in CAROUSEL are presented in the DROPBOX current app, but it is far from being close to the UX of CAROUSEL.

During this research, we have also been following other attempts to create photo managing tools for domestic photography, but the leading providers of cloud services such as AMAZON, MICROSOFT and GOOGLE, are making significant efforts to create and improve their customer photo managing tools and, in most cases, they are doing it for

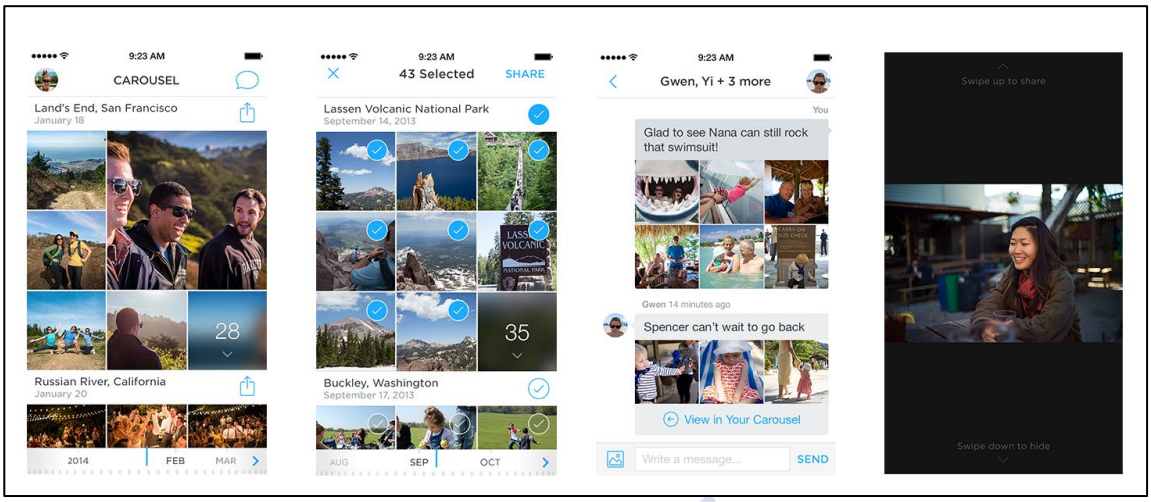


Figure 36: Carousel Interface as presented in Dropbox official blog the day of its presentation. (© Dropbox Inc)

free. This alleged altruistic interest of big companies focuses not only in providing a safe place to store images but also in offering a comfortable experience when viewing, organising and sharing those images, as they understand this is the core value to keep users on their platforms. This potential interest of big services companies was already pointed out by Sarvas (2011) and more deeply studied two years later in an article explicitly focused in the role and interest of those companies in users' data (Sarvas, 2014).

There are also new actors that are trying to offer solutions to domestic photo management. One example is ADOBE, which has extensive background and experience in developing photo managing tools as LIGHTROOM or BRIDGE. Adobe released in late 2017 a cloud-based LIGHTROOM mobile and desktop version that targets the amateur and enthusiast photographers. The mobile app covers most of the services offered by the apps we have analysed in this study, and it is slowly adding AI processing in both the editing and the tagging of the images. However, this is a payed subscription service that has no free plan available. Another company that has recently approached mobile photo manage is SYNOLOGY. The NAS manufacture is now offering a mobile app with very similar services to the apps we have studied, including AI tag creation and face recognition but, in this case, all the storage and processing is done in the user's NAS.

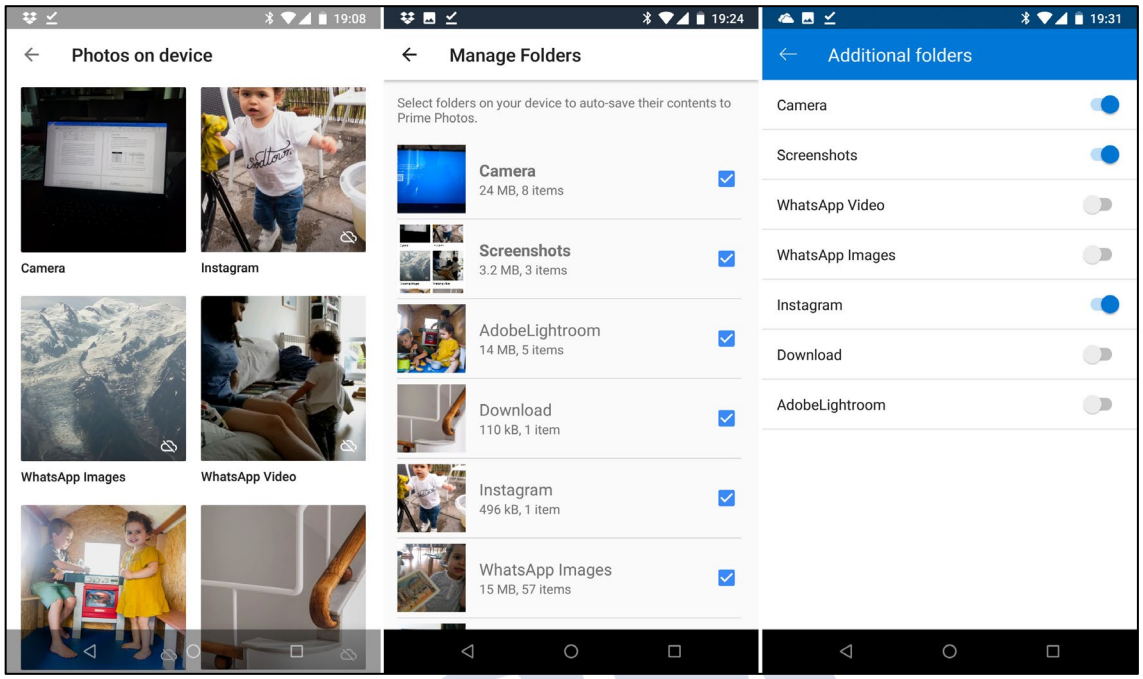


Figure 37: Google Photos (left), Amazon Prime (centre) and OneDrive (right) menus to choose which folders to sync. (CC Andrés Fraga. Screenshot of the software installed on an Android phone)

In a recent work, Broekhuijsen et al. (2017), studied the curating habits of 12 participants. At least two of them were using systems that are discontinued such as APERTURE and PICASA. Those systems were both software installed on a computer and in both cases part of the organisation created by this software had problems to export images to another system. This is an excellent example of the importance of using systems that allow users to export their images to different services easily and properly.

3.4.2. Freedom to choose which images to upload

We firmly support that automatic syncing of the photos taken with a mobile phone is a necessary characteristic of any system. The fact that smartphones are quite easy to lose, to be stolen or damaged (Siciliano, 2012) makes more necessary to copy the information stored within them to an outside secure place.

We have seen that there are two main options to choose what is and what is not synced with the cloud. Some of the apps do not let the user choose what sources they

want to sync. This filtering is done by syncing all the photos on the phone or by selecting only specific folders. In both cases, the user can see their experience affected. In the first case, by having their photo gallery filled with photos that, in some cases, can be automatically downloaded from some apps. This occurs in apps like WHATSAPP, and those pictures might not have the importance that other photo sources might have, like for example, the camera. On the other hand, limiting the number and typology of the folders that will automatically be synced is somehow putting some of the photos from specific origins at high risk of disappearing, independently of the value that the user has decided to give to that specific folder.

We believe that the middle point chosen by GOOGLE PHOTOS and lately by ONEDRIVE and PRIME PHOTOS is the most appropriate for the user. By letting the user choose which folder he wants to sync, as seen in Figure 37, the user is allowed to decide which photos must be kept and which must not. The fact that it is the app that asks the user if he wants to sync a specific folder every time a new folder is created avoids the sluggishness of the users on what is related to organise their photos and limits their effort to answer yes or no in a pop-up window.

The fact that most of the systems have chosen to implement this feature enhances the usefulness of giving the user the ability to choose. This is a coherent approach to solve the problem of users having many sources for their images. Most of those sources are organised by different apps, which implies that being able to remove the photos of one specific app from our systems can help to avoid the entrance of unwanted images in the system. We still believe this is not a complete solution, as the typology or importance of the images is not always related to the source. One user might have an abundant entrance of images via WHATSAPP he does not want to keep, but also some pictures of, for example, a close relative. Those images might have a great interest form him, despite having the same source. In this case, filtering only by the source is not a final option for the user.

One attempt to solve this problem is the Archive section on GOOGLE PHOTOS, where the user can send images that should not appear on the timeline but are not to be deleted.

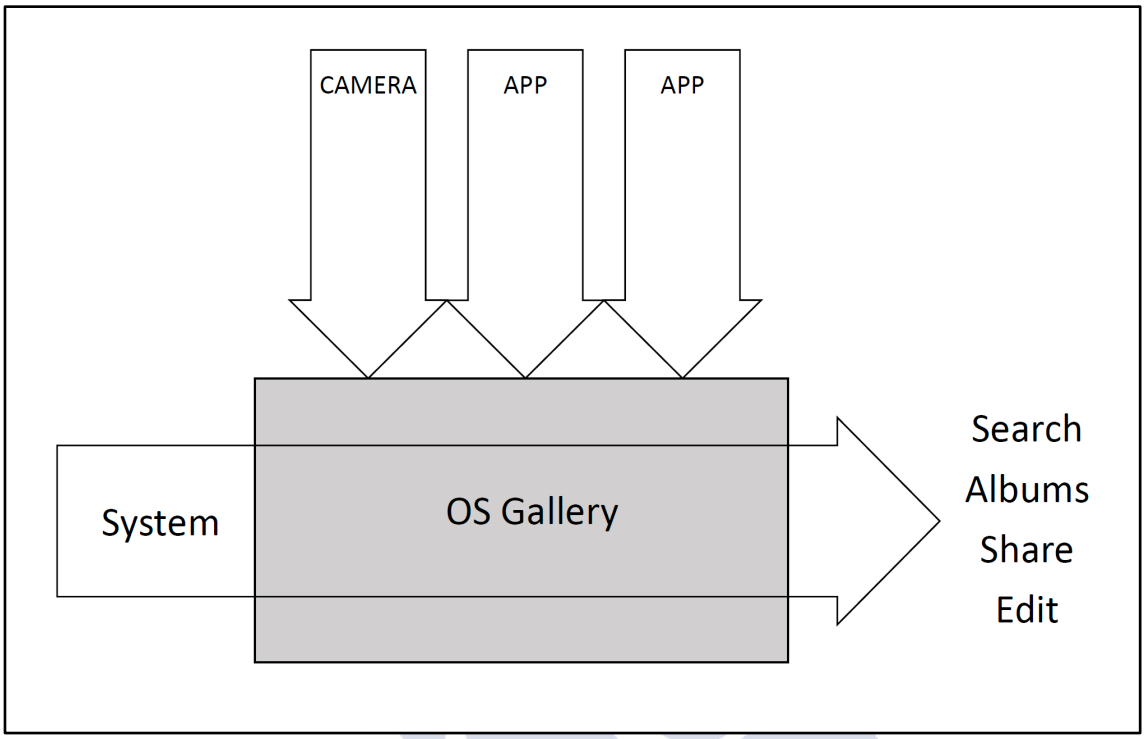


Figure 38: Graphic showing the way iOS force the systems to work with a unique image gallery. (CC Andrés Fraga)

GOOGLE PHOTOS automatically suggest that the user's selections of photos should be moved to this folder, generally pictures from documents or screenshots. Similarly, PRIME PHOTOS offer the possibility to hide some images without the need to delete them.

However, the main difference here is between different OS. We have seen how IOS lack of folder system forces all the images to be stored in the IOS camera roll, limiting the capacity of other apps to filter the images they want to sync by source. As we explain in Figure 38, this forces all systems to manage all the images on the device. In contrast, ANDROID allows apps to create different folders, enabling them to choose which sources they want to access and sync, as is shown in Figure 39.

As previous studies have shown, users tend not to delete their images (Whittaker et al, 2009; Jansen et al, 2014; Ofcom, 2015), and they want to have the final decision on what images to delete (Zürn et al, 2018). However, a more personalised version of what GOOGLE PHOTOS is doing now with their Archive folder could help improve the overall experience of photo browsing. We think that systems should also offer the possibility to

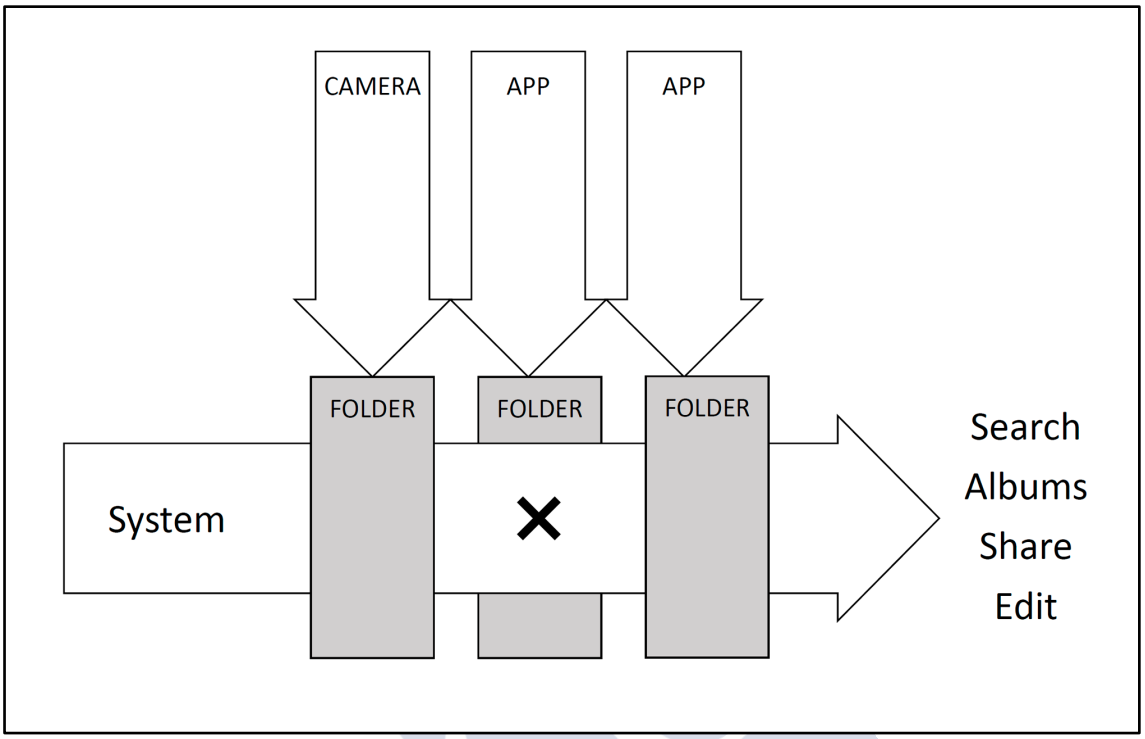


Figure 39: Graphic showing the way Android let systems create their own image galleries. (CC Andrés Fraga)

add rules or automate actions to this "archive" folder in a similar way as it is commonly done in corporate emails, allowing to protect images with certain people (for example users' children), specific locations or other rules based on the information that current AI systems could create. Users could later decide if they want these images to be synced or what use they want to give them.

3.4.3. From the cloud to the computer

Although some of the systems we have analysed here come from different origins, they have all ended working as kind of cloud services. Some of then began as social networks, some as part as an operating system and others are multiplatform services, but they have currently reached a similar point. Their main feature is that they take the pictures out of the phone and store them in a safe cloud service. Until that point, they all

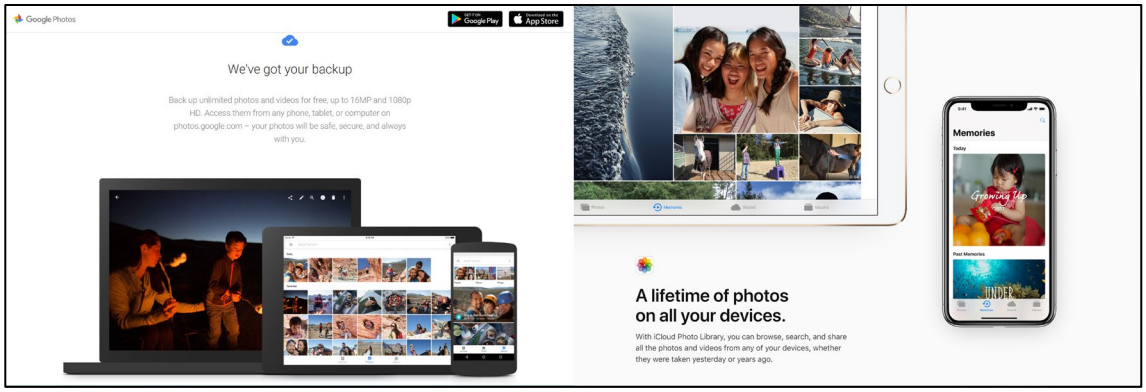


Figure 40: Google Photos (left) and Apple Photos (Right) promotion of their systems on their websites. (© Google Inc and © Apple Inc, from www.google.com/intl/es/photos/about/ and https://www.apple.com/macos/photos/)

have succeded in doing it, despite having used different methods and having achieved different levels of effectiveness and simplicity.

The main difference comes in the way they manage those images once they are stored in the cloud. Here we have seen how most of the services have gone to systems than unify the photo experience through different devices, allowing the user to observe and, in most of the cases, keep a copy of their smartphone photos on their computers. Some systems also allow the user to see their computer pictures on their smartphones. This integration in two directions is an excellent way to help integrate previous snapshot collections made with consumer digital cameras. Although the camera market is decreasing and focusing more on the professional and amateur photographer, it is also essential to consider that smartphones and digital cameras still have to coexist.

Companies have been advertising the ubiquity of their systems as a central feature, as we can see in Figure 40. In the case of IOS, APPLE makes particular emphasis on that point when talking about their PHOTOS app by using slogans like "*All your photos. Always with you and picture perfect*" and "*ICLOUD Photo Library. All your photos, on all your devices.*" GOOGLE PHOTOS also emphasises this ubiquity with sentences like "*Access them from any phone, tablet, or computer on photos. GOOGLE.com – your photos will be safe, secure, and always with you*". In the image we can see how they also include the GOOGLE PHOTOS interface in three different devices: laptop, tablet and smartphone.

APPLE has decided to strongly unify all their photo management system through one service, ICLOUD, and one app, Photos. Even though the app on the phone and tablets and the one on the computer are slightly different, the fact that they are named the same and that the sync is made through the app gives a very unifying multiplatform user experience. Similarly, WINDOWS 10 has simplified the way to see and manage photos on their desktop app, but it lacks a specific app for mobile OS, so the user experience gets a bit compromised. Other companies like GOOGLE, AMAZON and DROPBOX have developed tools to sync their images back to the user's computers but lack the native experience of using a proprietary app and they depend on the web experience and appropriate Internet connexion. The case of GOOGLE can be a bit different, as they understand their web browser Chrome nearly as an OS where all their apps/services run. This decentralised infrastructure makes it more challenging to keep it simple, especially for the user that usually uses more than one service at a time (Sarvas & Frohlich, 2011). The latest version of their desktop app Backup and Sync includes the possibility to sync images from a computer or a specific folder of the computer, and even an external drive, to GOOGLE PHOTOS. This improves the experience but it is still is a one direction solution.

In the previous chapter, we have seen how even though nearly half of the users use at least one cloud service, most of them keep a copy of those images in a computer or an external hard drive. Either by lack of trust on the cloud services, unfamiliarity or the will of having access independently of the connexion; the result shows that users are interested in having a copy of their photos and we have seen how most of the systems are not fulfilling that need.

3.4.4. Events, Albums and automated curation

The IOS Photo approach, which organises all the photos into events, has in our point of view, some disadvantages. On the previous chapter, we have seen how nearly the same percentage of the users use their smartphone camera to take photos of events, to take notes or document daily moments. With this kind of images in a gallery, the iOS approach consists of forcing all the photos to be part of a selection ends up creating numerous

"Moments" that contain a single image, or group various images with no connection at all between them in the same "Moment". Something similar happens with the images that users receive from other sources like WHATSAPP, that can be incorporated into a "Moment" despite the photos not having any relation. In Figure 41 we can see an example where three images created a "Moment": where one is a picture taken with the smartphone; the other is a screenshot of a WHATSAPP conversation, including the previous picture; and the third one is an image received by WHATSAPP with no relation at all with the two previous ones. The only common issue in these three pictures is the day they were created.

However, having the possibility to choose which sources the user wants to sync does not fix the whole problem. The automatic creation of albums used by ONEDRIVE does not have any curation process, as it creates albums for every weekend that has pictures, independently of the value those pictures can have. Therefore, the user ends up having an album for nearly every weekend or week.

We believe that the approach of automatizing the album creation is more accurate in the case of GOOGLE PHOTOS, as it is not forcingly including all the pictures in a selection. It is true that the sporadic images will have little chances of being included in an automatic selection, but we believe that the way to put those images in value has to work differently. Mainly, it should take into account that the primary information for those automatic selections is date and location.

A system based in location can work well for special occasions, as well as the date, but it seems very unhelpful for daily pictures. One example could be the case of a new-born, those images will probably have a substantial personal value for the user but are taken in a random choice of times and mostly at the same location: at home.

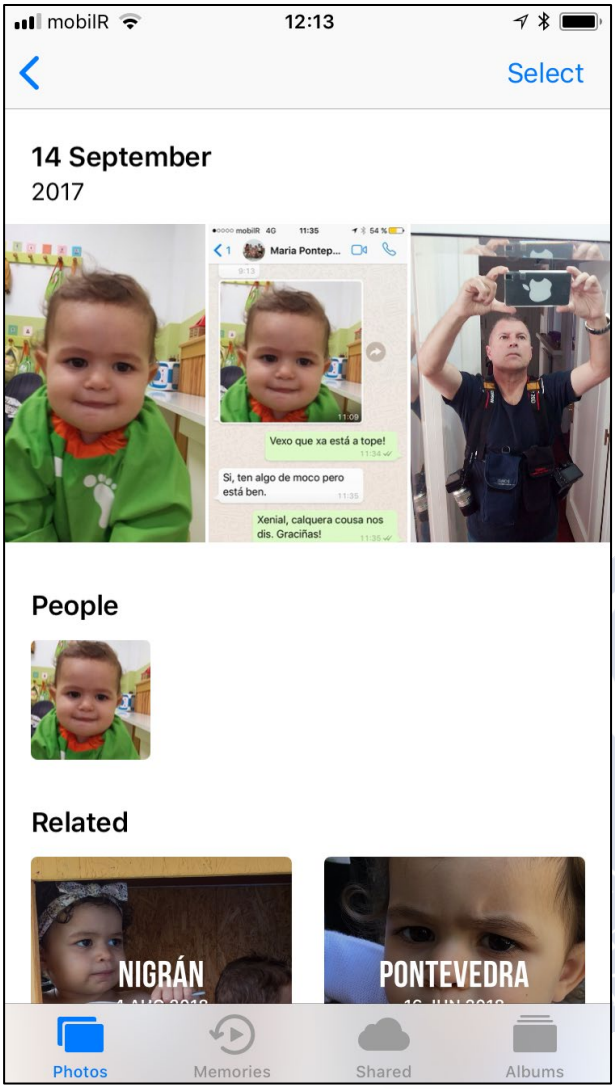


Figure 41: Example of a "Moment" where a picture taken with the camera coexist with a screenshot and an image receive by WHATSAPP that has no relation at all with the two previous. (CC Andrés Fraga. Screenshot of the software installed on an iPhone)

The automatic creation of albums shows an interesting path to organise and filter the vast amount of images that users have to manage. Studies have shown how home-made images gain interest when people invest in creating a memory bank (Chalfen, 1987). Therefore, it is also important to offer the user the tools and facilities to create albums where they can spend time curating their favourite selection. The ability to create short movies, collages and animations offered by GOOGLE might be a good way to increase the users' implication in organising their photos and therefore, increasing their final satisfaction.

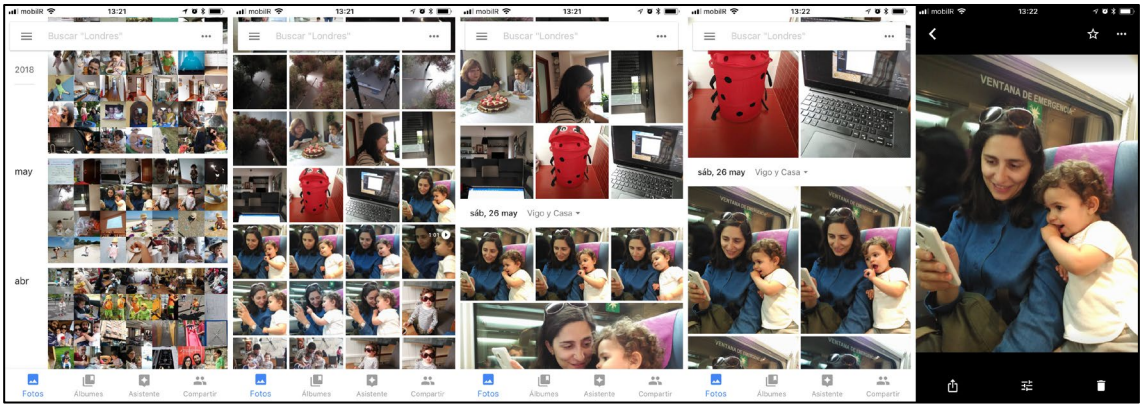


Figure 42: Example of different views of the timeline in Google Photos app in Android. (CC Andrés Fraga. Screenshot of the software installed on an Android)

One of the interesting features we found in the AMAZON Photo app is that it allows the user to convert existing folders into albums. This feature does not have any sense if we think in a fully mobile system, as we have seen most of the systems automatically collect images from all possible sources, but it is advantageous in a period of transition where the majority of the users still have most of their digital photo archives in folders in their computer. All the other systems also allow auto-upload to the cloud service, which could work to unify all the user's images. However, all the previous work that most of the users have done in organising their photos by folder (Whittaker et al, 2009) would be lost. Solutions as this one from AMAZON could be an important point in the success of a system, as an integration with the pre-smartphone is necessary to be able to fulfil all the photo management necessities for long-term retrieval.

All systems have established designs to allow better UX when browsing. The case of GOOGLE PHOTOS is probably the one that has the most options, as it is offering up to 5 levels of "zoom" while browsing through images. From a view organised by years to a two-column view where titles separate days. In Figure 42 we can see an example of the five levels of "zoom" of GOOGLE PHOTOS ANDROID app.

IOS PHOTOS work similarly, but their levels of "zoom" are organised with events in mind. Photos have also a years view, but then it jumps to Collection and Moments. As we have mentioned before, single isolated pictures can create "Moments" that will slow

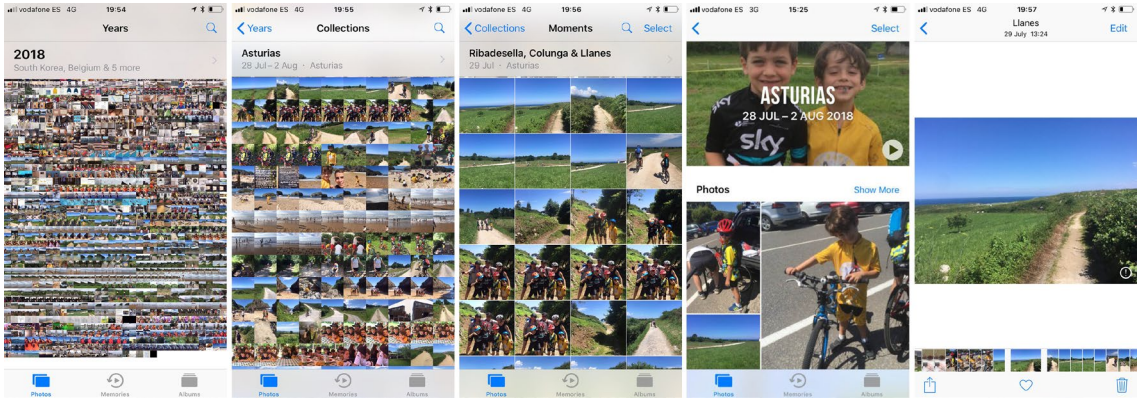


Figure 43: Example of different views of the timeline in Photos app in iOS. With views by Year, Collections and Moments. (CC Andrés Fraga. Screenshot of the software installed on an iPhone)

the browsing experience by giving the same level of importance to a single picture than to a week-long bike trip. An example of this is depicted by Figure 43.

Many researches have highlighted the importance of browsing (Bentley, Metcalf, & Harboe, 2006; Kirk et al, 2006) so it is crucial the systems allow the adaptation of the browsing experience to the goal of the user, whether their search is goal-directed or not. Those different levels of "zoom" into the navigation through images are a good way to keep frustration away while searching. At the time of our second sample only GOOGLE PHOTOS and Photos had such options, but at the time this research was finished both ONEDRIVE, in ANDROID and IOS, and PRIME PHOTOS, only in IOS, had also included it, so it seems like systems have understood this necessity.

3.4.5. Triggering as a tool to remember

The Flashback option was first introduced by CAROUSEL and it was an excellent tool to meet the need for a trigger that previous research had pinpointed. Even though this service was discontinued with the closing of CAROUSEL, it is significant that both GOOGLE and AMAZON have implemented similar solutions to their systems. Although both of them use notification on the smartphone to draw the user's attention to check past moments, GOOGLE PHOTOS created a space where users can go and search for those triggers without having to wait for the system.

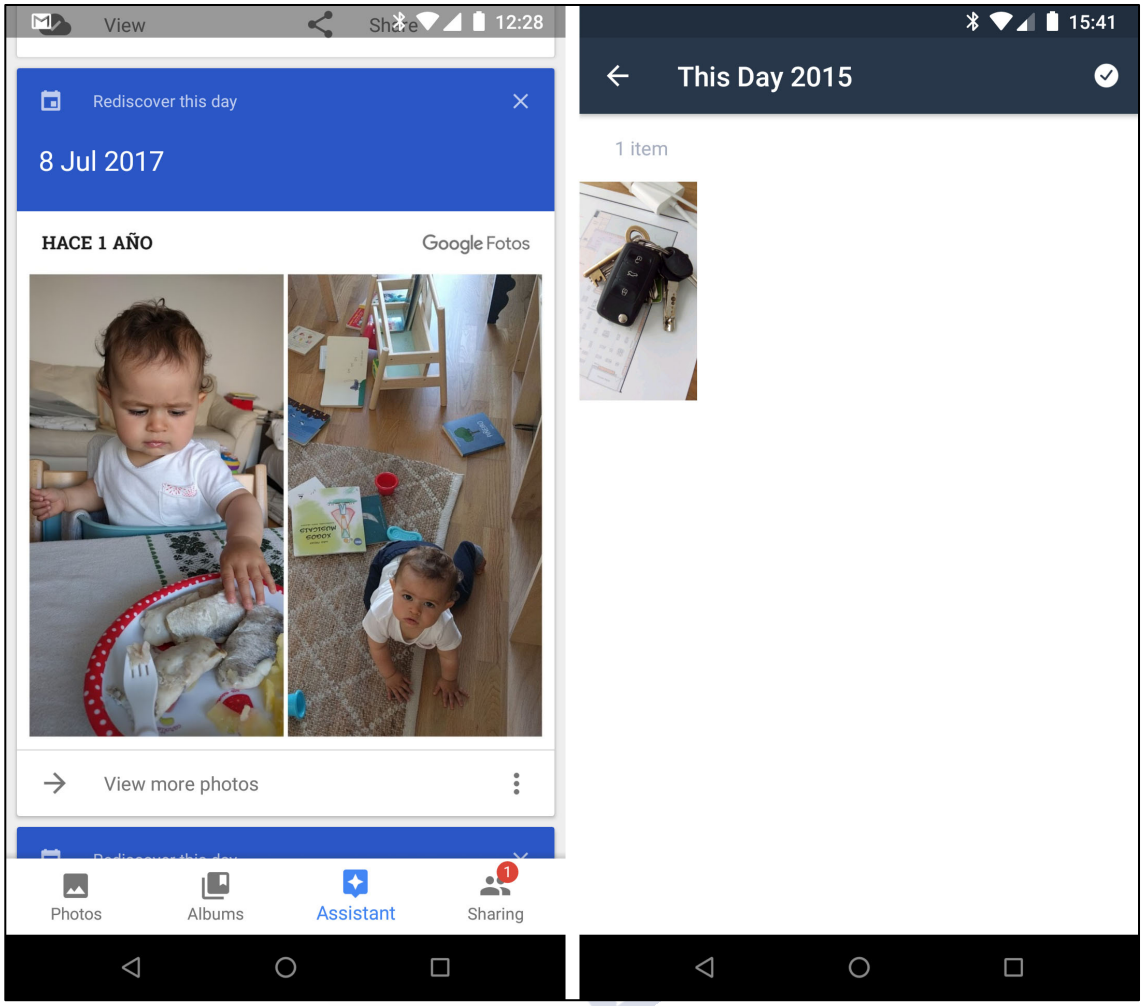


Figure 44: Google Photos "Rediscovering this day" and Prime Photos "This Day". (CC Andrés Fraga. Screenshot of the software installed on an Android phone)

The "Assistant" tab in GOOGLE PHOTOS includes selections of photos from previous years, video creations, collages and automatically created albums. That means that the user can perform many curation activities in a unique space. For this reason, it seems contradictory that PRIME PHOTOS does not have the "This Day" tab that previously appeared on AMAZON PHOTOS and it is available on the web version of PRIME PHOTOS.

However, despite having both a very similar service, the reason to "activate" that trigger is different. Apps like Timehop (Timehop, 2018) work by being connected to all your social media and cloud storage and search for all the content you created or posted on that specific day in previous years. This usually puts users in the situation where he is

receiving daily notifications about content that might not have any value. However, this does not tend to happen with GOOGLE PHOTOS.

In our experience, we have seen how GOOGLE PHOTOS algorithms create notifications with a more natural experience and achieve a higher level of satisfaction. To do so, it uses a combination of visual quality, more extended timespan periods with photos (that could reveal an event) location and people (Olanoff, 2015). Moreover, people are an active element, as we can see in the example shown in Figure 44: Google Photos "Rediscovering this day" and Prime Photos "This Day". In this case, GOOGLE PHOTOS created a card with a collage of two images made one year before. That day only 11 photos were made, the first group of 6 between 9:30 and 13:16, made at home and featuring the owner's daughter. The second group of 5 was made 200km far away, between 16:06 and 17:45, featuring the same owner's daughter and two of their nephews. Despite those first photos being taken randomly and at home, with no critical information concerning the location or time span, they show up as important to remember. In this same figure, we can see how PRIME PHOTOS "This Day" has chosen a picture that was created exclusively to send via WHATSAPP, with no memory value whatsoever.

Although GOOGLE does not reveal all the processing behind "Rediscover this day", is quite probable that there is much more happening for that selection of random photos of a baby, taken at home in a Sunday morning, to be chosen. However, the most important for us is that following only criteria of "event", those photos would have never been displayed, despite the very positive reaction it has had on users.

3.4.6. Sharing

Focusing on the possibilities of sharing both single photos and albums, we have noticed two main approaches. All the applications allow sharing one photo via multiple services using the OS menu that allows all the apps to share some of their files with other apps on the same device. In that way, the system downloads a copy of the image and then allows the app in use to share those images. Independently of the app used, email, instant

messaging apps or social network, the user is creating a new copy of their images, losing in many cases the control and track of those photos (Crabtree, Rodden, & Mariani, 2004).

The other solution offered by some of the systems is to create digital spaces available for other people to access the user's photos. It can be made by creating a link that would give other users access to a photo gallery. In that case, any user with that link would have access. Another option provided is to give access only to specific users with a credential. That second option increases security, but it limits the range of people that can have access to the ones that have opened an account on that specific service. This access can usually work via a browser or even via the same app, in the case that both users have the same app installed. The level of control, in this case, is more significant, as the owner of the photography can modify both the content and the access other users may have.

These sharing options, again, increase the problem of long-term sharing, as services and accounts tend to gain and lose interest in their participants. Even though it could be argued that long-term sharing was not a reality with the printed album, as users only shared their albums when someone physically came to their homes to see it, we understand that sharing is no longer an action that goes behind the home walls, as now the domestic space consists of various users creating and storing their personal photo albums. Sharing must be, therefore, an action that can be done inside the closest family structure.

The solution offered by GOOGLE PHOTOS for sharing the whole library, or a selection of it with other people, can help mitigate this problem. Instead of creating a unique space for all the family pictures, it creates multiple spaces with a series of mutual images. Having multiple family albums complicates the photo-talk even more (Whittaker et al, 2009) and the construction of a collective family image (Prieto, 2010), as comments and the necessary context to the photo collection can be different for all the users.

Another issue that still must be addressed is the management of the legacy account, as for now, shared libraries allow users to see photos from other users but do not give any privileges over it. Companies like FACEBOOK and GOOGLE have some processes to

manage accounts after the user dies, but they are still far away to solve the many problems that digital authorship implies.

3.4.7. Metadata: storage and edition of the needed context

In the use of tags or keywords, we found different approaches that are strongly linked to the different types of information that can be collected by the system. We have decided to organise this information into three types: camera-generated, user-generated and systems-generated metadata.

The smartphone camera can create metadata with the date and the location where the image was taken together with technical information from the camera specifications and characteristics of the shot. This information is created at the moment the shot is made by the smartphone camera software and it is the same independently of the system. This information is mainly stored in Exif format.

The user-generated metadata are the comments, descriptions or tags that the user can add to every image. This information could have been added before in other software, mostly in the case of old digital photos imported to a cloud system or manually added by the user in the system app or web service. Both systems, ONEDRIVE and FLICKR, which allow the user to write their tags, can read IPTC keywords. ONEDRIVE converts user tags into IPTC keywords; but in the case of FLICKR, even though it respects those previous tags, if the user downloads the image, the tags that it has created inside FLICKR will not be present in the metadata. That means that FLICKR is reading IPTC but not writing it.

Finally, the system-generated metadata is the information that a specific system can add to a photo, generally using AI that reads the content of the image and translates it into words (Honan, 2015). This process is made once the image is uploaded to the cloud service of the system, where the image analysis takes place. This metadata is generally stored in the cloud service of the system and it is not attached to the image if the user downloads it. If the user finds a specific photo via app search, for example dog, once the

	Camera			User		System
	Date	Location	Exif	Tags	Description	AI Tags
Photos	YES	YES	YES	-	-	-
One Drive	YES	YES	YES	YES	-	NO
Dropbox	YES	YES	YES	-	NO[1]	-
Google Photos	YES	YES	YES	-	YES	NO
Flickr	YES	YES	YES	NO[2]	NO	NO
Amazon	YES	YES	YES	-	-	-

Table 12: Metadata export following EXIF and IPTC standards.

1. There is no description field, but space for comments.
2. If the tags are previously created on software that uses IPTC, those can be downloaded.

photo is downloaded from the server, this tag will not be accessible by the user; at least not following the standard IPTC fields.

Both ONEDRIVE and FLICKR create system tags, but also allow the user to write their own tags. There is a primary difference in how they manage those tags. ONEDRIVE users' tags are written in the image following IPTC standards and can be read in the Keyword field once the image is downloaded. In the case of FLICKR, those tags are again not attached to the file and once the image is downloaded will not be accessible.

In the case of GOOGLE PHOTOS, the system works in a slightly different way. GOOGLE PHOTOS App does not list the tags attached to an image in the app but allows the user to find this photo while searching for some recognisable event or object in the image. This image recognition technology creates a great user experience and works well, but again,

	Camera			User		System
	Date	Location	Exif	Tags	Description	AI Tags
Photos	Search	search	-	-	-	-
One Drive	read	read/ search	Read	read[1] / search / edit[3]	-	search[2], edit
Dropbox	read	-	-	-	edit[1]	-
Google Photos	read / search	read / search	read / search	-	read / search / edit	search
Flickr	read	read / edit	read	read / edit	read / edit	read[1]
Amazon	read	read[4]	-	-	-	-

Table 13: Metadata associated with the images and levels of access for the user.

1. Only in the web service.
2. User can choose, but not search.
3. Only if the image already has user's tags. If not, the tag field does not show.
4. Only in iOS if we look at those three metadata typologies we have commented.

it is completely lost if the user wants to download the image. We have seen how the different systems choose to use tags differently, allowing the user distinct levels of access. In Table 13 we have represented the different options the user has to access this information.

3.5. CONCLUSIONS ON CURRENT MOBILE SOLUTIONS

Metadata typology

There are three metadata types: camera-created, user-created, and the system-created. Camera-created metadata contain information on camera settings, capture date and time and location info as coordinates and orientation. User-created metadata are all the information the user adds to the file in the shape of description, title or comments as well as any mark, such as favourite stars, colours or flags. Finally, the system-created metadata is the information that the photo management system creates based on AI processing.

Proprietary metadata

Camera and user-created metadata are mainly stored using EXIF and IPTC standards, and are legible by most of the systems, while system created metadata are property of every system and are not attached to the file in case the image is downloaded from that system. Users do not have access to that information if the images are moved to another system and have no guarantee of keeping that information in case the system disappears.

Systems should allow users to attach system-generated metadata and user-created metadata to files using one of the current standards such as XMP, that englobes EXIF and IPTC.

AI-generated context

AI-generates tags and search methods are an excellent tool for users to find specific photos in vast collections of images that are not being documented and/or curated. However, tags, if they are generated by a computer, have only one interpretation, as the importance of every image depends not only on the content of the image but also on the

moment the image is being watched and who is watching it. Users must have the possibility of adding their tags or contextual information to both help and correct the systems

Freedom to choose

Users should have the possibility of personalising what images should be part of their photo collection. Systems should provide the user with the opportunity to choose what pictures should be synced by selecting the source. They should also work in the direction of using some of their AI to allow the user to increase the number of filters. Systems should work behind all of the other apps that receive and create images organising and curating all the different image sources. They should not limit the user's options about image sources and image use. User experience must be seamless between different OS and devices.

Automatic curation must be relevant

Automatic curation of images, together with the appropriate triggering, is a good way to improve storytelling and retrieval. However, this automatic curation process must be relevant to the user. Any automatism must provide extra value to the user and must allow the user to choose if the task performed by the system and the new information created is or is not relevant.

Ability to create rules

Systems should allow the user to create rules that allow him to personalise more the curation experience. They should give users access to their metadata to allow them to automate actions like tag creation, moving to archive or not syncing based on all the metadata the system have access.

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CHAPTER 4 THE EXPERT'S VIEW

4.1. USERS AND INDUSTRY: TWO POINTS OF VIEW

As we already explained in Chapter 1, this study aims to look at both sides of the problem: what is creating the problem and what can fix it. The two previous chapters have drawn complementary conclusions that, despite being the result of two investigations made on the same topic, are different. This is because when we ask the question "what happens with the personal photos we have in our smartphones? we have different groups of people in front of us.

On one side, the users, the people with the problem. This group, as we have seen, is quite heterogeneous, with significant differences not only in age and gender but also in experience, cultural background, social level and language. As smartphones reach an increasingly higher percentage of the population, the diversity of this group will only increment. We have seen in Chapter 2 how this contrast is enough to create different habits and needs that can generate design problems. People from different ages have very different habits as well as unequal levels of experience with smartphone use, this also involves its tools and services.

On the other side, we have the systems. By systems, we mean OS, apps, clouds, webs and even the hardware itself. All of them are being used through a smartphone and, in

many cases, they look similar, but they have different origins, implementations and possibilities. The six systems we have studied in this research have different implementations for each OS as well as different versions of the same system coexisting at the same time and having to deal with different OS version. Moreover, the hardware is also important, since not all the devices have the same processing power and storage capacity. Even the speed and reliability of the network has a significant influence. However, we should not forget that working behind all those systems there are people with different professional profiles. Developers, UX designers, software architects, researchers, and of course, all the management team that, in the end, must prove some profitability for the company behind each system.

Even though we have focused our attention on these two roles, it would be naïve to think that this is a two-players game, as there are other agents involved here. Social networks, smartphone manufactures, phone carriers and legislators, among others, have also impacted the way the user can use and access their photos. One clear example of that is the case of GOOGLE PHOTOS and FACEBOOK'S facial recognition and how European laws have blocked this function for European users (Griffin, 2016).

To help us to obtain more cohesive results from our prelaminar conclusions, and to reach a better understanding of the consequences that those conclusions might have, it is essential to listen to both implicated parts and have a transversal approach. Richard Chalfen's book Snapshots Versions of Life is one example of that. Chalfen creates the concept of “Kodak Culture” that, in his own words is:

> Kodak Culture will refer to whatever it is that one has to learn, know, or do in order to participate appropriately in what has been outlined as the home mode of pictorial communication (Chalfen, 1987)

To develop and understand this concept correctly it is very important that the discussion is linked to the business model of, in this case, KODAK. Similarly, Sarvas and Frohlich (Sarvas & Frohlich, 2011) have also expanded their research to include the evolution and fate of the leading photography companies. In their historical explanations

of domestic photography, they link the existing relation between photo habits and KODAK advertisement and how the KODAK business model has shaped the concept of domestic photography. They also look at companies and business models when they try to shape the future digital path. Some years later, and as part of the exhibition *#Snapshot, Cameras among us*, Sarvas (2014) wrote a very interesting article called *Less Pictures, More Metadata: The Story of Snapshots in the Digital Age*, exclusively focused on the impact that the business models of the leading companies behind photo practice are affecting the snapshot culture itself.

The industry is, of course, making significant efforts for improving their photo services. We have seen in previous chapters how the four leading companies in global market capitalisation, APPLE, AMAZON, ALPHABET (GOOGLE) and MICROSOFT, have all developed and improved their photo management tools for mobile devices and they are now offering some of the best solutions for their customers. It is essential to insist that those are not the biggest tech companies in the world; they are the biggest companies in market value in all the sectors. Official numbers are nearly impossible to get from the companies (Keane, 2016) but the fast advance and the importance that those photo applications have in those companies' ads and services shows that there are interest and investment from those companies in developing good photo experiences for both keeping their current users and increasing them.

Companies, and more specifically their research departments, have been vital in the publication of papers that have been decisive in the research of domestic photography. In the first decade of the 21st century companies like MICROSOFT, HP, NOKIA and YAHOO found and lead numerous studies in domestic photography. Many of these investigations have been fundamental for further development of both tools for the domestic market as well as for other researches in the academic world.

4.2. THE EXPERT PANEL

In order to obtain a better view of this reality and to help us reassert the conclusions of our two first chapters, we decided to discuss our results with a panel of experts. As we have explained in the introduction of this thesis, this methodological triangulation could help us obtain stronger results and verify our initial conclusions. The first idea considered for this part of the research was to create a large expert panel and apply the Delphi methodology (Adle & Ziglio, 1996) to find consensus around our conclusions. However, the Delphi method requires a significant commitment from the participants as it requires them to answer many questions on multiple occasions. We obtained confirmation that this method could be an obstacle to reach high-level professionals in our first contact in the industry. During Mobile World Congress 2015, at Barcelona, I had the chance to have an informal conversation with the former General Manager of FLICKR Bernardo Hernandez. I explained our research and our method to him, and he agreed to cooperate with us, giving us the contact of the people on the FLICKR team that could better answer our needs. However, he clearly exposed that it must be a short and precise interview with only a few questions.

This experience made us reformulate our strategy and study other methods to confront our ideas with experts. As a result of this reformulation, we decided to work with semi-structured interviews. There are many significant researches on this field based on interviews with groups of users (Kirk et al, 2006; Whittaker et al, 2009), and on many occasions the methodology described those as semi-structured interviews (Miller & Edwards, 2007; Frohlich et al, 2012; Seok et al, 2013). The most recent published works orientated on smartphone photo management have also used the semi-structured interview (Broekhuijsen et al, 2017; Zürn et al, 2018). This kind of interview allows the informants to express their views on their terms and lead to new resources. The use of semi-structured interviews was also a recommended choice while working with high-level profiles with limited time and probably only one chance to interview them, as it was with some of our experts (Bernard, 1988). To balance this different approach, we also searched for profiles with a different point of view, choosing experts that have dedicated

their professional career to research and development and that have made some significant contribution to domestic photography or snapshot photo management.

The interview with Juha Alakarhu was made in the central office of MICROSOFT in Helsinki on December 7th 2015 and lasted one hour and a half. Risto Sarvas interview was done on December 10th 2015 at the Futurice central office in Helsinki and lasted one hour. The interview with Richard Chalfen was made via mail and was the result of a series of e-mails between June 18th and October 5th 2016. The interview with Joshua Fagans was made via e-mail and was the result of a series of emails and responses made between June 13th and July 11th 2016. Interview with Jessica Bushey was made via e-mail and was the result of a series of e-mails and responses made between June 7th and September 21th, 2016.

4.2.1. Experts

- Richard Chalfen: PhD from the University of Pennsylvania, USA. He is Emeritus Professor of Anthropology at the Temple University of Philadelphia and Senior Scientist at the Centre of Media and Child Health of the Children's Hospital Boston/Harvard Medical School. He was one of the first to study domestic photography and his book *Snapshot Versions of Life*, published in 1987, described the Kodak Culture and set the basis of all current snapshot or domestic photography research. His main research area has been visual culture and he has focussed his academic career around what he describes as "How They Look", "This includes the dual perspectives of attention to look/appearance and to see/perception-worldview. One underlying tenet stresses the need to understand visual culture as intimately connected to other

Figure 45: Professor Richard Chalfen. (From Richard Chafen personal website)

codes and modes of human communication" (Chalfen, 2000). He is a defender of fieldwork, studying in situ and with their protagonists. His works around American middle-class families, Navajo in Pine Springs, Arizona, the Japanese American families of San Francisco and Japanese families in Tokyo were always done being around "ordinary people living their daily lives". During all his extensive professional and academic career he has defended he importance of visual cultural studies not to be limited to the public sphere such as mass media and fine art. Despite having done some research around mass media or visual research methodology, his focus was ethnographic media and home media. In that last area, he has examined children's filmmaking, family snapshots, home movies, tourist photographs and home video as well as postcards, family home pages and camera-phone usage. He is currently working at the Children's Hospital in Boston on projects that exploit a fluency and comfort in contemporary visual culture. Using snapshots and home video to improve both treatment and understanding of ailments.

> The visuality of contemporary culture is indeed pervasive. As pictorial symbolic environments become increasingly dense, work in visual culture must be built into notions of media socialization, image acculturation and communicative competence as well as both long term and everyday survival. It is an exciting place to be (Chalfen, 2000).

It is his in-depth knowledge of the Kodak Culture and traditional photo album what was the most interesting to us. His work about domestic photography and snapshot culture has been a constant reference in this work and a starting point for most of this research.

- Risto Sarvas: Graduated as a software engineer, he got his PhD at the Helsinki Institute for Information Technology HIIT of the Aalto University, Finland, with an awarded dissertation around media metadata. His post-doctoral work has been around photography and more particularly around snapshot photography and smartphone photography. Sarvas has worked as Head of UX & Service Design and as Company Cultural Engineer in the software and service company Futurice. He has led a multi-disciplinary research group, overlapping design, business, technology and society. He is currently leading the Information Networks program at Aalto University where he is an Adjunct Professor of the School of Science and Technology. He has focused most of his research on digital photography and metadata. He has studied the possibilities of mobile photography from the very beginning. His book, together with Professor David M. Frohlich, *From Snapshots to Social Media - The Changing Picture of Domestic Photography*, is a complete collection of the best research made in domestic photography. Sarvas has curated exhibitions and publications around domestic photography. He has an in-depth knowledge of snapshot culture as well as metadata use on smartphone photography. He also has experience view of the business-design relations.

Figure 46: Professor Risto Sarvas. (From Risto Sarvas's personal Medium page)

- Jessica Bushey: PhD in Archival and Information Studies by the iSchool, at the University of British Columbia, Vancouver, Canada, focused on access and preservation of social media, new photographic practices and community archives. With a background working as a professional photographer, Jessica has developed most of her academic career in the field of Archival Science. She has been working in the information technology sector as Records, Information and Archives contractor at the United Nations Framework Convention on Climate Change and she is the actual leader and manager of the North Vancouver Museums and Archives, that not only preserve and make accessible public and historically significant records, but also private records from business and individuals. She is also Adjunct Professor at the University of British Columbia on the fields of digital photographic records, audiovisual and non-textual archives and open source software. Her work touches the delicate relationship between photography, social networks and archives. Her dissertation, *The Archival Trustworthiness of Digital Photography in Social Media Platforms* (Bushey, 2016), reflects her interests on contemporary communications and on their long-term implications. Her vision and knowledge of the archive science and their new implementation on the current panorama was the critical point to choose her for our panel of experts.

Figure 47: Dr. Jessica Bushey. (From Jessica Bushey's LinkedIn page)

- Juha Alakarhu: PhD in Digital and Computers Systems by the Tampere University of Technology, Finland. Graduate in Digital and Computer Systems, he soon focused his work on the field of digital images and digital sensors for smartphones. He holds patents and is responsible for some of the current standards needed for smartphone photography such as SNR10 sensor performance metric (Alakarhu, 2007). He worked at NOKIA for almost ten years in many positions reaching the position of Head of Imagen Technologies. With the acquisition of NOKIA phones business by Microsoft, he moved to Seattle, USA to work as the MICROSOFT leader of image technology teams. He has been behind products like NOKIA 808 and Lumia 1020, driving the complete imaging solution, from software to hardware. Juha has been behind some of the most significant changes in smartphone image technology. He went back to NOKIA to lead the Image, Presence Capture team at OZO, a 360º camera designed by Nokia. Right now, he is Vice President of Imaging at Axon. At the time of the interview he was Director and Lead Program Manager at the Phones Imaging department, in charge of the phone imaging end-to-end solution, including software and hardware. He has an in-depth knowledge of both the design process and the general industry point of view. He has experienced in first person the evolution of mobile photography and all the challenges it has created.

Figure 48: Dr. Juha Alakarhu. (From Axon press release)

- Joshua Fagans: Graduate in Physics by the Duke University, USA, he is a software architect. Joshua started his professional career in NeXT computers, the company that Steve Jobs created when he was forced out of APPLE. With the fusion of NeXT and APPLE in 1993, Joshua started to work at APPLE developing their new Mac OS Platform. From 2003 to 2015 he has been working on iPhoto, the main APPLE desktop photo management application. He has been deep in the core of the iPhoto evolution, reporting directly to Steve Jobs. He was also involved in the development of Aperture, the APPLE professional tool for photo editing, conceiving and implementing prototypes that were then integrated into the products. He is now working on the development of new photo software. His position on the development and design of both consumer and professional software gives him a privileged view of the industry's point of view concerning the problem of domestic photo management. He has lived the main changes and challenges of the digital photo management right from the centre of the action.

Figure 49: Joshua Fagans. (From NextPhoto site)

4.2.2. Topics to start a discussion

Following the conclusions of the two first chapters of our research, we have organised our questions in 5 topics to discuss them with our expert panel. The number of questions and the exact way they are written are not the same, as we wanted the speaker to feel comfortable and to move mainly in the field where they could prove their best level of expertise. That means that not all the topics were asked to all the experts and sometimes the same topics were not discussed with the same questions.

Complex Scenario: new photographic infrastructures, together with new social realities, have radically changed the concept of the family album. This new scenario has complicated even more photo management and photo curation in the domestic field. This new scenario has more sources, more pictures, more events and more places to store them, as we saw in Chapter 2.

System Operations: photo management has dramatically changed from "shoebox" and physical albums to current mobile and cloud bases systems. The centralisation of all the photo infrastructure in one unique device, together with the multiplication of sources and uses, creates new operations that must be solved in between the limitations of a mobile-only reality.

Lack of trust: the speed on the evolution of apps and services as well as the shift of the business interest from images to "streams" of images, leave users in a situation where it is challenging to follow those changes and they may lose confidence in these systems for preserving their images in the long term.

Family and Album: The traditional album was the hub of family photography. We focus on what has happened with the role of the photo album and what other alternatives are for a family space for photography.

Metadata: Images without context are meaningless. How are systems and users attaching the necessary contextual information to the images? What information is being used to provide images with context and where does it come from? Those are critical points for preserving the memory value of our images. However, how do we organise this information and under what standards is it fundamental to ensure the role of contextual information in the long term?

4.3. DISCUSSION

4.3.1. Increasing complexity of the current scenario

In most of the interviews we started with a similar question: do we have less time, or do we care less about photography? Chalfen goes back to the traditional family album to answer this question, and how the family album was designed to see and discuss the pictures when the family members were physically together, but now the concept of "being together" has changed and this "presence" is no longer a prerequisite for enjoying/using family pictures. Bushey answers in a similar direction, but focusing exclusively on the digital supports, and talks about how the different tools we used shaped users' habits. She also addresses how now most of the sharing is primarily done online through social media platforms. Sarvas goes a bit deeper into the subject and talks about how the value has changed, and how now it is not about a single photo; it is about a stream of photos. Even though, he remark that this does not mean users do not have any more individual photos that might have value. He also points here, how photography, as a culture, has changed into sub-cultures that change from one generation to another.

We do agree on this point in most of the comments. We do believe that people take care of their personal image. We observed in the first part of this work how a clear majority of the users tried to do something to preserve an image if they considered it has some unique value for them. It is also true that the continuous change in the tools and the digitalisation of the process have left a group of users behind, not knowing what to do. Older users that were used to solve the management problem of their personal photos with the physical album did not find a trustable alternative to curate their images. The same has happened again with users that have their method organised around the personal computer.

Another question related to the increasing complexity of the current situation comes from the affirmation Chalfen did in his book *Snapshot versions of life*: we are documenting 1% of our life. We asked our experts if with smartphone cameras we are documenting more moments of our lives, or if we are merely taking more pictures of the

same moments. In Chalfen's own opinion there is both continuity and change taking place, as we are documenting more moments of our lives, but with less thought to save all of them for the future. In the same way, Sarvas stresses how the emphasis has shifted to the present, to what is happening now. He also points out how current technologies are not helping to build our past for memory or documentation. Bushey also agrees that both things are happening and she emphasised how we now have much more images of every moment using as an example a family event and how every member of the family has their photos of the event. She adds the example of a graduation, where everyone in the family will document the moment from different angles and different devices.

In that sense, our conclusions line up correctly, especially concerning users documenting more moments of their life. We have seen how the uses of photography in smartphones increase when the experience of the user increases and how new uses that are directly related to the smartphone, as the use of photography as a live communication tool via instant messaging apps like WHATSAPP, are more present in young people's life.

With regard to that, the experts were asked about their opinion on the shifting role of photography, from memory to communication and identity. Bushey points out how each social platform has its characteristics and capabilities that shape how it is used and whether individuals use it for sharing their identity or as a tool of memory. Sarvas assigns an active role to the audience and remarks how differently apps are able to reach different audiences.

Coming back to Kodak culture and how KODAK was able to shape and influence domestic photography for more than a hundred years, we asked who was drawing now those guidelines of how snapshot photography has to be. We wanted to know if it was mobile manufactures, social networks or if it was coming from outside the industry. Regarding this respect, Sarvas claims that what happened with KODAK was an anomaly, as it was strange that only one company was so dominant. He points out how the culture about domestic photography and its role on identity and togetherness existed before KODAK. What KODAK did was to shape it into a direction and they emphasised it by building a nostalgic past, since it suited well their business mode. He also highlighted

how the academic world has study photographs and family albums, but the business part of it has hardly ever been brought up.

For Bushey, photography is a sociotechnical practice that has evolved through time in response to social and technical influences. It is in this direction that current research goes. We believe that future studies on photography can no longer be understood without the necessary study of the technological changes that continuously affect photography, especially in the non-professional world. We also agree with Sarvas that the business model behind all the actors in the photography industry must be studied to understand the motivations behind their movements. This must be applied particularly nowadays, since the leading companies shaping the future of photography are not focused exclusively, or even mainly, on photography, as they are all tech companies.

As more companies such as GOOGLE, Microsoft, APPLE and AMAZON are building devices that allowed the wireless stream of information from smartphones and tables to a TV set, we decided to ask about the role of TV screens on photo-talk. In that sense, there was an agreement that this is not a common practice in the domestic spaces. Bushey also points out that smartphone screens are getting bigger and images can be more easily watched. Despite this fact, we believe that it is essential to keep an eye on the role the TV can have in long-term photo retrieval. From one side, the industry is offering this service, and as we have just said, the leading four companies have their products allowing that. We also believe that products like GOOGLE HOME and ALEXA open new possibilities to share images in the domestic space easily. Those new devices have been introduced during the time this thesis was done and the most recent announces, with products like GOOGLE NEST HUB, shown in Figure 50, and AMAZON ECHO SHOW opens a very interesting door in this field. Further research should be conducted in this direction.

As a consequence of this question, we talk with Sarvas about the photo-talk discussion around screen-based photo curation and how this has evolved in the last ten years. Sarvas comments that of course, people talk about their photos, but now a lot of this discussion goes into the medium, it can be FACEBOOK or another social network, even

Figure 50: Nest Hub, from Google, allow user to interact with the images of their google photos collection outside the PC or smartphone. (© Google Inc. From Google Store site. store.google.com/es/product/google_nest_hub)

though he doubts that it must be as riching as face-to-face interaction would be. He also adds a very interesting point that he considered to be critical. He asked himself if it is photo-talk, in the Frohlich et al. (2002) terms, or if it is just talk that includes these photos. There is text, there is video, there are photos and there is something else, advertisements, he pinpoints.

As a final question to this section, we asked if they think that photo management will be simplified to a more stable infrastructure. Bushey focuses her answer on social networks and she comments on Facebook and Instagram and how their monopoly will be a severe concern in the years to come. Sarvas starts his answer by considering photo research. He says that photo research started with the fact that photos are important. He does not deny that indeed they are, but he thinks that we must be sceptical about the use people do of those apps. Do people use those apps for photography, or do they use it for something else and photos are an important part of that? He commented how, in the Kodak world, everything was centred around photos, but now, looking at WHATSAPP,

SNAPCHAT or even FACEBOOK, it is more centred on communication. Photography is an integral part of that communication, but people are not necessarily always thinking about photography.

We understand Sarvas's consideration and we agree that it is important to have a more open view of what is driving the user's interest. However, we also believe that the systems we have studied here, especially those from GOOGLE, AMAZON and MICROSOFT and APPLE, are more centred now on photography. They are releasing specific photo apps for both mobile and personal computer platforms. We reckon that they are trying to attract the user's interest in their services by offering a more photo-centric experience, promising security and privacy on their services.

4.3.2. System Operations as a limiting factor

We started this section with questions about the browsing experience. We wanted to know if, now that most of the systems work on providing an easy way to find a targeted picture, the browsing experience could be positive. Regarding that, Chalfen points out how, in some cases, browsing can be a highly time-consuming and that people often complain that it takes so much time to find something. Hence, if a quick search is required, browsing can produce an increasing feeling of anger and frustration as the number of stored photos is continuously increasing on users' smartphones. In comparison, he also points out that, if the user has enough time, browsing can be delightful, providing memory support and entertainment.

Fagans adds an interesting fact here, as he states that users do not always know exactly what they are looking for. He says that even if a system could correctly tag a photo, there is still an issue where the memories are “faulty”, meaning that browsing, in some fashion, will always need to be part of the solution. Those two comments are aligned with what we already saw on Chapter 3, as we have seen how most of the systems are implementing powerful search tools, but they are also implementing ways to allow users to browse their pictures comfortably.

As we have seen that more and more photos are being taken outside an event limited in time, we asked if they thought that the *event* system to organise pictures is dead. Alakarhu's answer is very straightforward in this case: "yes". He said that the *event* should be a caption or a label, but not the root of the organisation. Fagans has a different opinion, since he explicitly says that the *event* system for the organisation is not dead. He points out that events still exist in our lives and are still important, but we have not found a good way to characterise photos that are captured outside of events.

Although we agree that there are still events in our lives that deserve to be photographed and are essential to people, we do find interesting the Alakarhu's idea of keeping the event as a caption or a tag. Our study shows how less than 5% of the users use their phone exclusively for special events. That means that an event-based system will have to deal with too many pictures that are exceptions outside the standard organisation system based on events. Even if we do not have data on the number of pictures users have in every category, the variety of sources and typologies allows us to assume that this quantity is large enough to create a management problem. Looking at the systems, we can see how all of them have an "event-free" view. Even IOS solution, that force all the photos to be in Collections and Moments, has a view, in the All Photos album, where the user can watch all their photos without any grouping.

In our research, we found that only 5% of the users had pictures on their phones that came exclusively from their camera. The rest have pictures from at least one more source that could be mail, social networks, screenshots or apps like WHATSAPP. We wanted to ask the experts if they believed that those images should be treated differently. According to Chalfen, people are generally enthusiastic about collecting pictures and getting them anywhere they can. He also points out that it is not only about family photography anymore, as many other pictures have no relation to what was consider family photography. He suggests it is a good example of asking the original concept of "Kodak Culture" to do many things. Fagans points his view in the practical problem. He pinpointed out that the images that we captured and received on our mobile devices are fragmented across a significant number of apps and services with no way to coalesce them. He thinks that this is a fundamental problem that needs to be addressed and that

those images can and should be centralised in some interesting way. Bushey's point of view focus on the access/privacy restrictions and copyright issues. She emphasised that those might be different for images the users receive vs the images the user creates. The Bushey answer opens a new door that needs more research and dedication, as it should also be considered what rights the users have over their photos storage on cloud services.

We agree with Fagans that this is a fundamental problem that should be addressed. We have seen in Chapter 3 the need for systems to work as a hub. Systems should capture all the images created or collected on a smartphone but, as Chalfen said, not all the images users have in their phone are content for a family album. Therefore, users need to have tools to sieve these photos before they get all mixed on the system, to separate those that might have a value from the ones that do not. We also point out how the source is a necessary filter to use because in many occasions it could straightforwardly eliminate a source of unwanted info and simplify the future curation.

An example could be screenshots; if a user often uses screenshots to take notes for professional use, he probably wants this information not to be mixed with their personal images. Having the possibility of blocking those images in their feed does not mean those images are condemned to disappear. We have seen how many users reconcile two or more cloud services, so in this specific case, the user could opt to use one system for their personal images and other for their professional ones. In the case of ANDROID, as it is possible to have more than one camera app, this same user could use one camera to take professional photos and sync them with their company cloud system, while filtering the rest of sources out of that system. This is possible to do with some apps in IOS but is more complicated to achieve for a user with little smartphone experience.

We have created a diagram, Figure 51, that resumes our proposal on how systems should treat images inside the smartphone. We propose that the system should be entirely transversal for all the device and it should create a funnel that could collect all the images created or received in both apps and OS, but keeping the sources differentiated. This funnel would allow placing filters just after the hub that allowed the user to block some unwanted sources. The next process should be documenting the images. Here, the existing

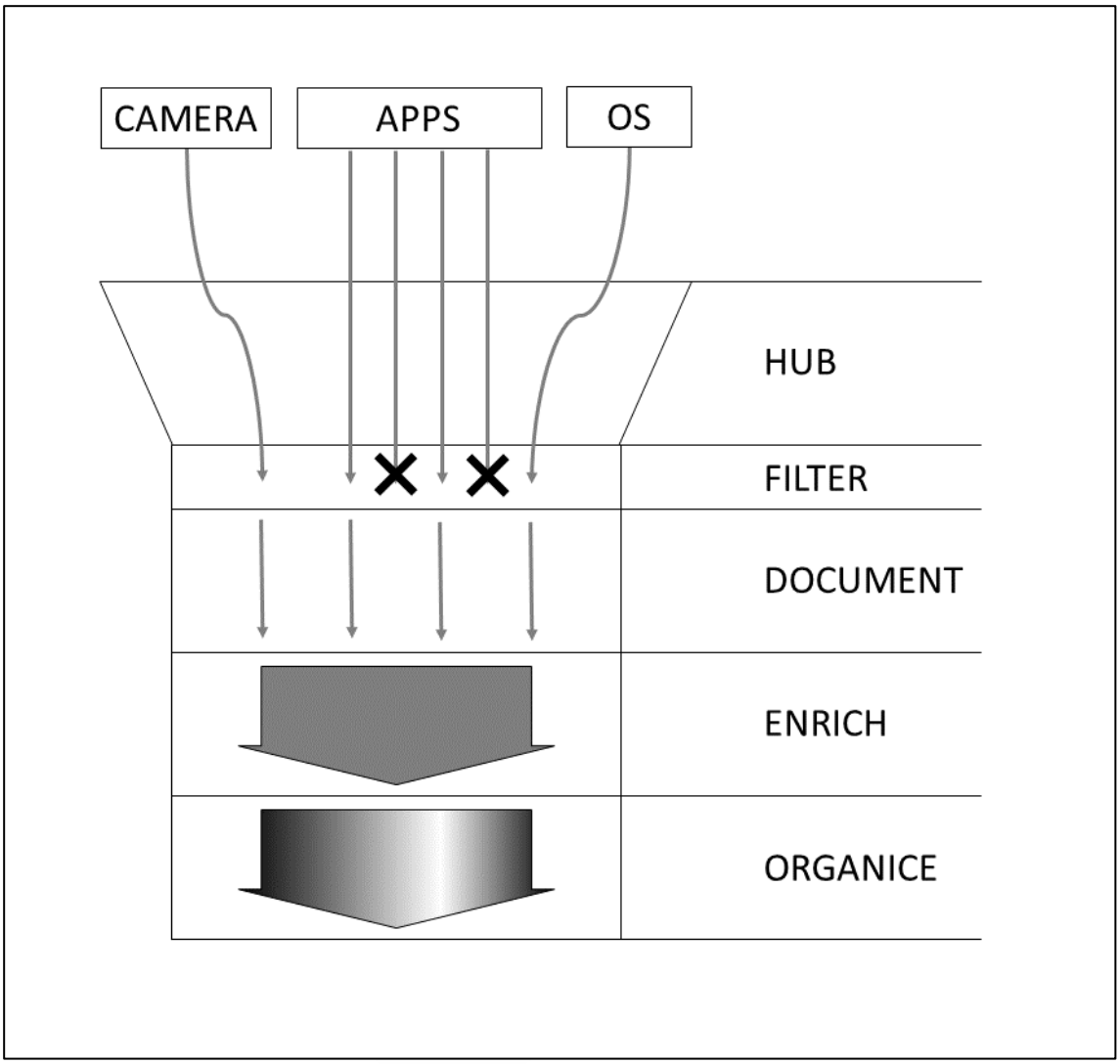

Figure 51: Diagram of systems photo management inside smartphones. (CC Andrés Fraga)

metadata attached to the images could be standardised. Considering that different sources could provide different types of metadata, we reckon that this processing should still be done independently for each source. To put it in a practical case, the metadata of an image generated by the camera would be exclusive camera metadata, but if an image is downloaded from another system as for example, FACEBOOK, it could come with associated tags or captions. In the following step, with the images already merged into one unique space, systems could enrich the images by adding AI generated metadata. After these steps, with well-documented images, the organization process could be performed by both the system and the user. Obviously, this is only a simplification of the

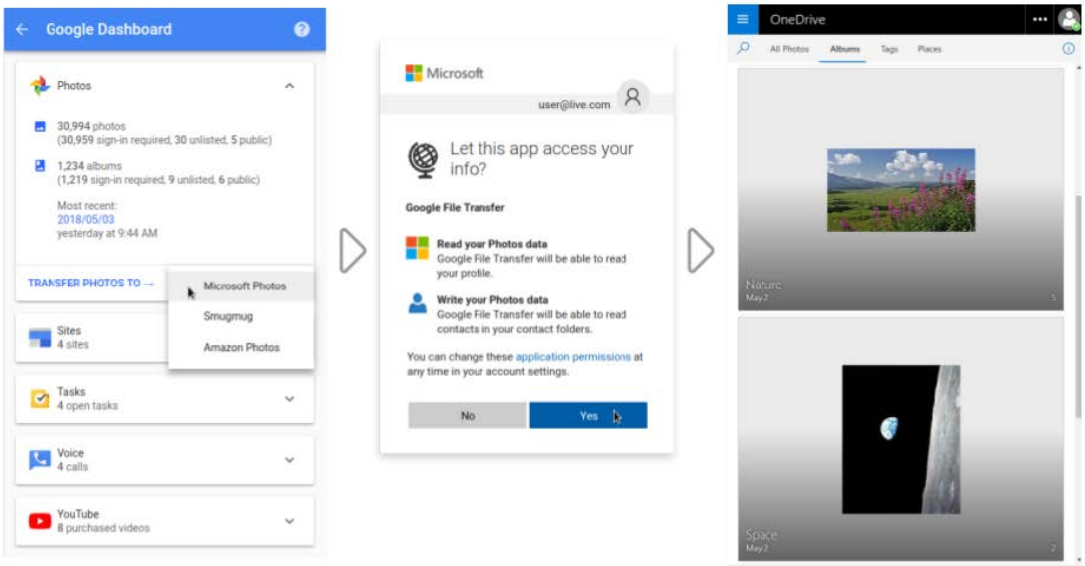

Figure 52: Example of use of Data Transfer Project extracted from their whitepaper. (CC DTP)

main route, the final process, with both metadata enriched and organized, could become more complicated depending on the system. In any case, it should maintain the user's possibility to edit and add more context to the images, as we concluded in Chapter 3.

The future development of the DTP (Data Transfer Project, 2018) could provide more straightforward solutions for this problematic. If all systems and apps had a standard output for metadata, this step would become unnecessary. If, as we proposed in Chapter 3, all systems exported their image with aggregated metadata under the form of IPTC and EXIF, this process could be more direct. DTP is still in a very early stage and it is too soon to verify whether the rest of the companies outside their promoters are willing to accept the implication that the use of DTP can have in the movement of the user between platforms. In Figure 52 there is an example of a user that want to change their images from GOOGLE PHOTOS to ONEDRIVE. Using the tools of DTP, the user could move their photos and their albums to the new service without the need to download the images to a device and upload them again to the new service.

Another situation that shows up in Fagan's conversation is the need for systems to work with pre-smartphone photos, coming from digital cameras or scanned printed

photos, which are typically very poor on metadata. He stresses that all digital images should be in the same place, but the problem is that current organisation systems "don't mesh well with updated or fuzzy dated photos". On our research we have seen some features that have tried to fix this problem. On the one hand, PRIME PHOTOS allows users to convert the folders into albums. That could help minimise the impact of having old digital images organised in folders. On the other hand, GOOGLE PHOTOSCAN app enables an easy digitalisation of printed copies and integrates them directly on the GOOGLE PHOTOS stream, empowering the user to transfer their old printed copies to digital support with the minimum friction.

However, both solutions lack a metadata tool that allows to create a new context for those undated images. This problem has existed since the arrival of digital collections (Girgensohn, Adcock, Cooper, Foote, & Wilcox, 2003), but the current mobile solution has not made any advance in fixing it. In the case of GOOGLE PHOTOSCAN, once the user has scanned a picture, the date of the scanning day will be the only metadata in the picture, not the original capture date of the image, which is probably far away in time from it. Although GOOGLE PHOTOS have the option of changing the data in their web service, there is not a bulk editing possibility and there is no option to do it on the phone at the moment of scanning. That would be a more efficient solution as, once the user has made the effort to scan their images, the "non-leisure component" of photo curation as Chalfen said, it is easy for the user to complete the process in the moment of the scanning and not later on the PC.

The last question we made concerning the operation was if there was a need for a trigger that should remember the user to check their photos. Photo displays, "rogues galleries", as defined by Frohlich and Drazin (2007), and family albums were physical objects that were normally located in visible spaces at home. Personal photos or digital albums share the same space with all the other apps inside a smartphone. For Alakarhu this trigger is missing, he mentions ONEDRIVE notifications from last week or weekend, but he also recognises this is not yet a solution. He also points out that it would be interesting to know if the content generated by the computer about these notifications, is going to fell personal for the users. Fagans also agrees that this is necessary and thinks it

is in part a failure of the software developers, adding that the right tools have not been created yet. He also stresses that everything that may lead the user to revisit old photos is great. In both cases, we also debated if these review moments should be used to curate images and both agree that it might not be the moment. In Alakarhu's own words “Not everything is so important”. Fagans adds a very interesting approach when he points that not everybody has made albums before, so he is not sure that a digital analogue of an album is the correct thing to strive for now.

Sarvas's point of view concerning having a trigger is more sceptical. He asked back for who is this important. He goes in the line of his article *Less Pictures, More Metadata: The Story of Snapshots in the Digital Age* (Sarvas, 2014) and said that this can be important to FACEBOOK or DROPBOX because of their business model or because it increases the value of their product for people, but its importance is different for users. Despite this fact, he thinks that that watching old photos is valuable for people, since it makes them be reflective on themselves. We also believe that this could encourage users to review and share old photos with other people and share those memories.

We have seen how systems are interested in this feature. Since CAROUSEL introduced Flashback, other systems like GOOGLE PHOTOS, ONE DRIVE and PRIME PHOTOS have included similar features. Regardless of the reason that pushed the development teams behind those systems to implement those features, we do believe it is an excellent service for the users. We have also seen how, to be useful, it needed to be relevant to the user. It is at this point where there was a big difference between GOOGLE and AMAZON approaches. In our opinion further research should be done to have better information about the users' opinions on this feature.

Again, the future development of digital frames and personal assists with screens, like GOOGLE Nest Hub and ALEXA Echo Show open new possibilities in triggering remembrances. However, it is essential to understand that new hardware implies new habits, and that it will require software development to be aligned.

4.3.3. From family album to family “and” album

In the introduction of this work, we have shown how domestic photography had been historically linked to family. We wanted to know how the current landscape has affected the concepts of the family album and family photography. With the level of penetration that smartphones have globally, most of the family members, from a very young age, have their own camera and their own photo collection. We wanted to know if with this landscape, is it still possible to create a family space for photography and how these spaces can be inherited, as they are not a physical object anymore. Chalfen turns his attention back to the early production of family sites and family web pages. For him, these were early digital albums that interestingly promoted more verbal and written “captioning” and narrative previously missing from physical album formats and encouraged more contributions (pictorial and verbal) form family members. Fagans, however, thinks that we are at the beginning of the age when this starts to get addressed since the first generation with an appreciable amount of digital content is getting to the age where they are thinking about this issue. Bushey brought out how digital assets held in the cloud are considered the property of the social media company and how the access to them will depends on the specific protocols each company have for those cases.

We have seen how some systems allowed the user to create shared spaces. GOOGLE PHOTOS offer the possibility to share all or a selection of one of the user's gallery with other users. However, this is not a communal space yet, as is not possible for a group of members of the family to contribute with their images. There is, of course, the possibility of creating shared albums, but again, the control and ownership of the images are still owned by only one user. This also brings all the problems related to the heritage of that image. PRIME PHOTOS has a service call Family Vault that it is designed to work in this direction, as it allows up to 6 users to contribute to the same space with their photos. Still, the ownership of the images is still at the user's level and all the access problems that Bushey points out are still present. We have not profoundly analysed this feature in this research, as it is not accessible in many European countries. An AMAZON Prime subscription is needed and the service is not accessible in Spain.

In our interview with Risto Sarvas, he introduces an important reflection about the role of WHATSAPP as a contemporary family album.

> "But this is again that family album, all that I am talking about is looking into the past, which is, of course, the core of the traditional family album, it is looking into the past. As the family albums is WHATSAPP now. Look at this WHATSAPP; this is couple of my friends (showing his phone), looks like an album doesn't it? But is not about the past, it is about the present. Here is my parent's and my sister, who lives in Norway, it is a family album, but is not in the past, is in the present."

We have decided to take this reflexion to Chalfen and Bushey's interviews and ask them if WHATSAPP family groups could be close to a family photo album. In that sense, Chalfen recognises not having enough information about the content and general thinking of WHATSAPP, but he focuses his reflexion on the content. He says it is important to reflect over if the content of the pictures from those sources is relevant to all "family" members and what o who is considered a member of the family. He also points out it may be necessary to consider the difference between "personal" and "impersonal", keeping in mind that the experience of watching a family album was surrounded by a mental framework that was personal-oriented, meaning viewers would know the people appearing the photographs and often know who took them and could anticipate who would be looking at them. Bushey, nevertheless, focuses her answer in the limitation that WHATSAPP could have from the archiving point of view. She points out that WHATSAPP archiving capabilities are limited and that "family photo albums" should be accessible to the future generations of the family.

With the result of our two studies it is difficult to obtain a conclusion on this matter, but we have found that there is space for more in-depth research in the role and functionality of photography in WHATSAPP family groups. What we can conclude with our data is that this application, and other similar chat apps, represent a significant source of images in the systems and this is happening without significant difference between age groups, gender, experience or whether they have young children. In addition to that, WHATSAPP is also very rich in contextual information, as pictures are commonly

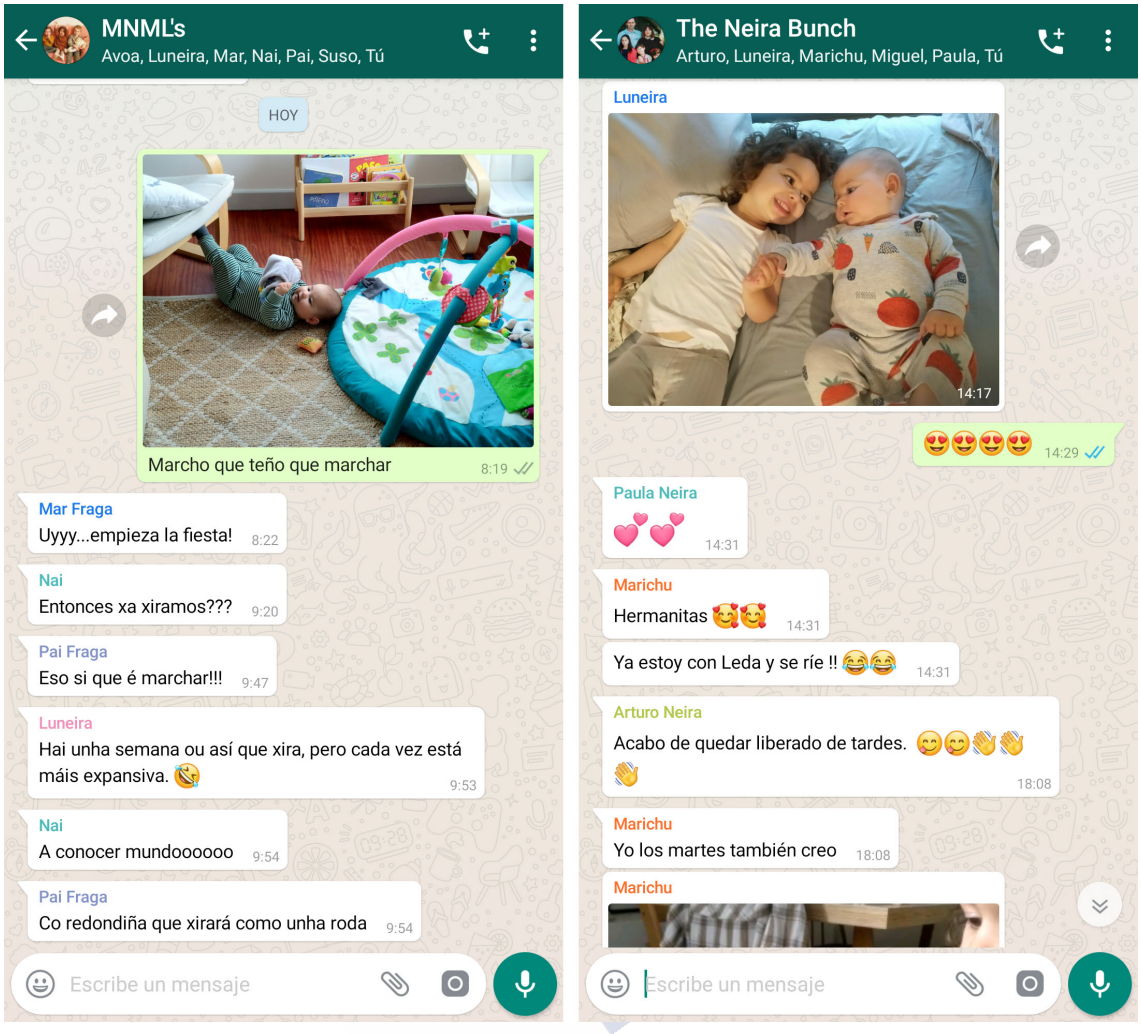

Figure 53: Two examples where a conversation is created around a photo in WhatsApp. In the first case, the comments after the image are related to the image and create a context that would enrich the image, like those in a traditional photo album. In the second case, the conversation mixed comments about the images with other information. (CC Andrés Fraga)

surrounded by comments by both the author of the image and the rest of the members of the group. The standardization of this contextual information could enrich the image metadata in a similar way that old handwrite captions were made in old photo albums. Nevertheless, this could create numerous new design problems. One example could be, defining which information is chosen to be transformed in the image metadata: exclusively user comments, comments from other participants or if the user should choose which info should be saved and who has access to this info. In Figure 53 it is possible to see two cases where there is rich contextual information around a shared image. However,

in the second case, it is difficult to differentiate what part of that information is relevant and what is not, as the conversation around the images is mixed with other topics. This goes in line with the comment made before by Sarvas about photos being part of a wider conversation more than a conversation around photography.

4.3.4. Lack of trust as a threat to long term retrieval

One of the more unexpected results of our first research was to discover that more than half of the participants in our survey had lost trust in preserving their smartphone photos in the future. When asked if they thought that their descendants would be able to see a photo taken with their phones, as they have seen pictures of their grandparents, 54% of them answer that "no, most of the pictures in my phone will probably get lost". In spite of this fact, the results of the survey showed that 43% of the users where using cloud services to hold their images and all the clouds included in the survey had apps that include an automatic backup of the device photos. That means the user either did not trust those services, or they did not know how they were working. When we checked the use of clouds among the users that do not expect their images to be seen in the future, we found that the percentage of them that are using cloud services is nearly the same. This behaviour is what let us talk about a lack of trust in current systems to provide a long-term retrieval experience. Still, we believe that it would be essential to have a better understanding of the reasons behind this frustration.

We asked our experts if they believed users had lost the long-term vision on photography. Chalfen starts his answer by stressing the importance that ordinary people ask themselves how their grandchildren are going to see the pictures that are being taken today. He points out that there is a sense of need in two main points now. First, the increasing number of pictures that are now rapidly expanding family members photo archives, and second, the ability to retrieve photographs when needed or wanted. He also points out how image production/viewing is changing at an extraordinary and rapid pace, even within the same generation of family members. Bushey's answer is short but very conclusive: "absolutely" and she adds how she believes younger generations view

photography as a short-term communication that documents “the now”. The idea of photography as a keepsake, something that is precious and will be stored and last forever is no longer applicable to the digital environment.

Fagan's point of view is a bit more optimistic; he thinks that long-term artefacts is beginning to be created for digital content as that content reaches a sufficient age. He says that digital content is still relatively new, and as such, has not needed to provide these “long-term artefacts”, but he thinks that we are beginning to see this change. We agree with this last statement, as our research shows how, despite the lack of trust of the user in current systems, there have done important steps in in keeping photos that are relevant for the user safe and retrievable. We have seen how most of the systems evolve to allow the user to back up all their photos, even via a mobile data connection. We have also seen how the use of face recognition and image recognition has facilitated the search and therefore the retrieval of old images, even in cases where those images have no extra metadata, as could happen with scanned paper photos.

Concerning this lack of trust, we wanted to know the experts' opinions on the use of cloud services. As we saw in our research, it is effortless for all the users to back up their images to the cloud, but the solution to have those images back is not always so straightforward. Some services like FLICKR, despite having the option to download their images, do not allow the user to have their images synced back to their computer. In GOOGLE PHOTOS, users no longer can do it via GOOGLE Drive, and even before, the space that those photos need is rested from their total storage plan, meaning that users with prominent collections of images would have to pay more to have their images synced to their computer. The rest of the systems, APPLE, AMAZON, MICROSOFT and DROPBOX, have an easy solution to syncing their images with the user's computer via their cloud software for both mac and pc.

Following this idea, we asked the experts if they saw the cloud as a way to store the images or as a way to sync images between devices. We also asked if they believe that users should keep a copy of their photos. Chalfen is very clear when answering that last question: “I strongly feel the user needs a copy!“. Bushey deepens more into the

problematic by stating that she considers that the user of the cloud is still new, so we still do not know all the ways it will be used or how it will impact user's approaches to storing, accessing and sharing their images. She says that she prefers to think in the use of cloud mainly as backup and synchronisation, but she thinks that for most people it is its primary storage. For Fagans, it is important that cloud services of their user's photos can provide with a way to download them if they are going out of business or if the user wants to move to another service. However, he emphasises how metadata, such as comments and likes, could theoretically be attached to the photos as they are downloaded, but there are definitely at risk of being lost.

4.3.5. Metadata and the need for new standards

The last part of our questions set was focused on metadata and their role on image organisation. We understand metadata as the best place to preserve the contextual information needed for a correct understanding of any photography, but in the case of snapshot photography, this contextual information is the most valuable part for the user, as this is the door to memory reminiscing and reflecting. Given that smartphones can collect so much information about our everyday life, we asked; if they thought this information should be used to create a context for our photos. We also asked them if the systems should also try to collect information from our social networks, as they have rich contextual social information.

Chalfen is very clear in his answer: “yes, of course, is my answer to the first question” and he emphasises that such information will enhance the value of the collection. Concerning the use of information extracted from social media, he does not feel so sure. We also asked him if he believed that the user should still always add some personal info and the answer is: “absolutely!” He comments that what users should do and what happens may not always overlap. Organising the traditional album and especially writing captions was the “work” or non-leisure component of the process and was often avoided and missing. And this was a time when family members felt their photographic records

would be interesting to their children, grandchildren and future generations of family members – all a part of long-term communication.

He emphasises that people have been satisfied to state that pictures speak for themselves, but he insists that they do not. He adds that family digital pictures are valued in very different ways – most importantly, not as long-term keepsakes – but short-range communication. Their value has changed dramatically in part because people feel that taking pictures is very easy and less expensive.

Bushey is also very clear in her answer stating that every bit of metadata the users can grab and save from all the devices, software and platforms is important. She also comments that image metadata can contain technical and contextual information about the how, when and where, and that it is the role of the user to find external programs to add the why and the who. She said that comments and tags are the providers of this information. Notwithstanding, Fagans claims that mobile devices do not have access to everything that was traditionally shared in an album. He says that mobile devices have access to a lot of data, but the experience of an event is not well represented in social posts. He also comments how, in the traditional album, information was not written down as it was transferred on the spot and that he is not sure what is the digital analogue if this, but he has not seen it yet.

In our research, we have seen how systems are already using some of the information they can grab to organise the user's pictures. Basic camera metadata like camera settings are not useful in this case. Even though this information is used on the professional world to either organise or improve editing, we cannot consider it as contextual information. If we take the smartphone model, this can already be useful contextual information, as it could allow the user to recognise the owner of the phone and therefore, the author of the image. One practical case could be if the user had two phones, a work phone and a personal one. Another situation could be the case of a couple that has a different smartphone model. This would allow one of the members of the couple to differentiate their images from those of their partner. Systems are also collecting location info, which is valuable contextual information. Although the location info is collected in the shape of

geographical coordinates, most of the systems can interpret those coordinates in place names. This last step would be, as Bushey said, the responsibility of the system. However, the system, as we have seen, can go further, and, again referring to Bushey words, give us information about the "who" in the picture. All big four, APPLE, GOOGLE, MICROSOFT and AMAZON have powerful face recognition tools, even if they do not make them accessible worldwide or on their smartphone app. This feature again allowed to create very rich metadata, but as Fagans states it is not all the info that was shared in a traditional photo album. Alakarhu talks about that in a point or our conversation and adds a good example:

> Machines do not see all the value that you have in those specific images, "this is the last pictures of my dog", How would the machine know it has such a wonderful value, it is just a picture of a dog. Of course, those algorithms can become much cleverer, and I imagine there is much research on how to know if this image is important to you. I am sure there is some machine learning that will teach what kind of pictures people would generally prefer for the image quality point of view, but for the content point of view, it is hard.

> The machine can do basic things quite well, like all the pictures of my daughter are very valuable to me, but it does not know the deeper content. When we move from Seattle to Finland, I took some pictures from the aircraft, and those pictures are valuable for me because they remind me that was the time when we move, but you almost need to be the person to know all that contest.

This reflexion takes us again to the conclusions of our Chapter 3 when we propose that users should always have the chance to correct or improve the system, because, in any other way, this in-depth knowledge of the context of the image would be lost. Although the user might not do this "non-leisure" action, in Chalfen's words, with all their images. We have seen in Chapter 2 how people still do actions with their favourite images, so that means they are still willing to "work" for their most precious images. Early before this work was finished, we have seen a simple but probably quite efficient try by GOOGLE

Figure 54: Photo of the moment when a child meets her sister for the first time at the hospital. Systems can understand who is in the picture and even that this is the first image they where together, but they cannot guess the importance this image have for the parents and, in the future, for both sisters. (CC Andrés Fraga)

PHOTOS by adding the option to choose favourite images. This favourite option was present in the old smartphones photo management systems (Fraga, 2013) and could allow the system to have, in a straightforward way for the user, extra information about the importance of that photo, despite not being able to understand the "why" behind this particular interest (Figure 54). Something similar happens with location info. Translating coordinates in the names of places is very convenient for the user, but again, the value that a place can have goes easily unnoticed by the system. Clever programmed algorithms can know where the user's home and workplace are and probability determinate this even in former homes without georeferenced information. However, there is other relevant information that would be lost. A specific bar where a user met their couple or a childhood place that a user is visiting with his or her daughter for the first time; those are examples

of important location info that systems would miss and a written caption, either in a traditional album or digital version of it, would probably be included.

Following the results we obtained in Chapter 2, related to the ownership of the images, we asked our experts about the theoretical possibility of knowing who took the pictures. Fagan answer straightforwardly by saying that he sees no reason not to record or at least allow the system to record who took the picture. Alakarhu finds that there it is valuable to have some way to tell that someone took some image. He thinks that it makes much sense and that there are opportunities, but he does not know precisely what the best way would be.

Based on our results, we have found that knowing the author of the image could help solve some of the filtering problems systems have, as we saw that filtering by source was not always a viable solution. We believe that having the chance of filtering by the author could allow, for example, to separate the desired content form the unwanted content that reaches user's smartphones via WHATSAPP. One example would be a case where a user wants to save all the images he receives took by his or her couple. Although face recognition could also help solve part of that problem (syncing only pictures of this person, or never syncing images of this other person) knowing the author of the image could help to fine-tune the filtering even better (syncing only the pictures sent by this person). Despite this fact, we are aware of the problem that this concept implies. Previous works (Sarvas, 2006) already pointed to some of the privacy problems that those systems could carry, and we indeed consider that it is a route that has many consequences that need to be further investigated. Still, we agree with our experts that it is a valid approach.

In order to have more technical information about the use of metadata, we asked both experts from the industry if they thought that former metadata standards, IPTC and EXIF, were enough to deal with the new needs that smartphone photography and photo management have created. Alakarhu answers that EXIF enables developers to do whatever they like, but the problem is that all the suppliers are using it differently, and the same is happening for IPTC. However, the biggest problem, according to him, is that the user's cases are very different and everybody wants to develop all the possible uses.

That given, the standard will be lagging behind. We also talked about the new image formats as Live Pictures, Living Images or Live Photos and how those could be a problem for the user. Those new features add a short clip that automatically reproduces when watching the image or via a simple gesture. Regarding the new formats, he thinks that they need to be standardised and it probably will be some basic current use cases that eventually could be core use cases and those will be standardised. However, that would take some time.

The case of Living Images is perfect to describe the risk that those formats have. When talking about living images Alakarku comments the following:

> "we are now storing it in the jpg, in the metadata, but it is not a standard way, it is the way we did it, and MICROSOFT photos will understand, but if you take those photos to another ecosystem it would not work. So, the whole question of what can you save to a jpg and how it is interpreted requires standards."

In our test, in 2019, a Living Image picture made with a Lumia phone with WINDOWS 10 is no longer reproduced in a current WINDOWS 10 PC or any other mobile OS. Users can still see the image, but the short video clip attached to it is no visible. The file is still there and it is still possible to get access to it by operating the file, but the original experiences are lost. New images formats such as APPLE HEIC file format (Apple Inc., 2018) that work more like a container than as a strict file format would probably help to solve the dilemma between innovation and standardisation pointed out by Alakarkhu.

Recently, GOOGLE PHOTOS and ADOBE LIGHTROOM CC added support for HEIC files and now it is possible to, for example, see a Live Photo taken with an IPHONE in an ANDROID device or the browser of a computer using GOOGLE PHOTOS. This is still far away for a standard as, for example, we could not manage to make GOOGLE Motion Photos taken in an ANDROID phone work on an IPHONE, even if we were using GOOGLE PHOTOS. This lack of standardisation opens new debates that show the need for more research as well as the necessary efforts that companies must do in order to find a common

point to develop standards. However, we still believe it is important to bear in mind this lack of standards while talking about mobile photo management.

Given that both Alakarhu and Fagans are very familiar with professional photo management software, we asked both of them if they thought that the professional way of working in photography, where data and metadata and the processing of that information are separated, could be used in snapshot photo management. Regarding this, Fagan agrees that IPTC should allow users to document their images but points out that, from the industry point of view, nobody is thinking about moving photos between services right now. He states that companies are more worried about expanding their feature sets and keeping their use within their service. He adds that, ideally, if a user received a photo from another person in a chat app, it would contain the fact that it came from the other person, where it came from and potentially any metadata the user thought was ok to share: location, likes on FACEBOOK and others.

Alakarhu talks about LIGHTROOM, an ADOBE professional tool for photo management and editing, and adds that its best value is that everything is organised. He adds that making that kind of system available to the consumer would be attractive, but in any case, independently of whether the user has an archive or not, the question that people might ask is “show me the pictures from last summer” and in that case, the system has to work. He thinks that separating data from processing is a very natural thing, because when systems or intelligence evolve it will also cover the user's back and the archiving is something that is not happening during the capture time but in a posterior analysis.

He also points out that there are not so many things that need to be archived during the capture of the photo and that almost everything that can be collected at the capture time is saved now. Maybe it is just the photographer behind the scene who is missing. He concludes that both systems could coexist, the original raw metadata and the processed information, as the metadata give the user some hints and the review system can provide more info.

In this sense, we agree with the experts. We think that the experience in photo management that the professional world has developed in nearly thirty years of

professional digital photo is of great value. Those programs were designed to work in the most transversal way, as they were only one piece of the whole process every photography would go through. Interoperability was here a must and developers work hard to provide it. Of course, the domestic software must be much more straightforward, but this simplification should not imply a loss in user's rights and possibilities.

ADOBE LIGHTROOM CC and their mobile versions is a good example of how all the needs can be balanced. It provides automatic sync of the photos hold in the phone with their proprietary cloud and the ability to create albums and perform searches about metadata. It lacks some of the remembering features or automatic album creation, but in contrast with most of the systems we had analyse here, all the curation work made by the user is saved in the image in a standard way, using IPTC and EXIF data. It does have AI image recognition, but here again, the results of this information are opaque to the user and cannot be exported.

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CONCLUSIONS AND FUTURE RESEARCH

5.1. CONCLUSIONS

1. The hypothesis that current photo management solutions for mobile devices are not working as long-term tools for memory has not been thoroughly validated, as some of the services have successfully incorporated tools for image retrieval. It has also been observed how the systems have been integrating different triggering methods that could facilitate their role in preserving memory.

   Despite that, they fail to incorporate the human context needed to create reminiscing and retrieving.

2. Systems have failed to provide tools to rank and filter the number of incoming images on smartphones. By only providing the option to filter by source, users cannot keep their photo collections clean of non-relevant information. Once the images are synced to the systems, the current solution for curation and filtering looks insufficient to separate the relevant images from those which that are not.

It is essential to mention that services like GOOGLE PHOTOS, PRIME PHOTOS and ONEDRIVE have made significant advances in this sense. It is also important to highlight that the limitation that IOS has by only having one photo gallery creates serious problems by not giving any system the chance to filter by source. We considered this limitation to be a critical failure.

3. It is essential to create more advanced and personalised filters to separate the relevant images from those which are not and this should be done before they get all into the system. Systems should also allow integrating sources as a metadata typology, enabling the user and systems to use a source not only as a filter but also as a search parameter. They should also give the user access to all the available information to create protocols and automatisms for actions such as tag creation, album creation and filtering.

4. Most of the systems include AI processing in the creation of tags. Those processes have worked efficiently identifying objects, people and some events such as weddings and birthdays. However, this information is not stored in the image as standardised metadata and it is not possible for the user to export it. Users should have access to all the contextual information the systems have stored as well as the resultant information of the system processing of previous metadata and data.

   Keeping this information linked to a platform might seem like an excellent strategy to keep the user in a specific platform but jeopardises the long-term retrieval of the context of the user's image. This strategy puts the role of photography as a memory creation tool at risk. Therefore, there is a need for specific legislation in order to protect the user's interest.

5. AI Systems processing is being developed so that the need for human curation can be avoided. However, systems should allow users to add, edit and delete the contextual information created by AI as this might be mistaken or just because there is valuable information that AI systems cannot access or

understand. AI processing should also be able to learn from the user's habits and preferences.

6. Although most of the image research orbits around smartphones and their ecosystems, there is still a need to investigate how to incorporate previous digital collections and digitalised analogue photography into current systems. Systems have implemented some tools to respect the previous organisation in folders, as it is the case of PRIME PHOTOS, or to scan old paper images, as PHOTOSCAN by GOOGLE, but these solutions have not been spread to the rest of the systems and are still far away from being decisive.

5.2. FUTURE RESEARCH

1- The authorship of the image should be included in the metadata as a factor to rate the value of the image. The information about the author of the image can be a factor that could help create useful filters and assist with the hierarchy of the images. This information could be used by both users and systems. It is necessary to be conscious of the privacy implications that this could have, so in-depth and cross research and discussions are necessary.

2- The role and functionality of photography in WHATSAPP family groups. Both the results of the users' habits in smartphone photo management and the opinion of consulted experts show that WHATSAPP and similar apps can play an essential role in the construction of the family photo space. Although WHATSAPP is not a specific photo app, family groups have revealed themselves as a delimited space where image and contextual information is organised. There are significant possibilities here in creating a contemporary family photo spaces like the traditional photo album used to be.

3- New DTP Data Models and standard photo-orientated metadata. The recent announcement made by FACEBOOK, GOOGLE, MICROSOFT and TWITTER concerning the creation of the Data Transfer Project opens a very interesting door to solve one of the main problems that have been pinpointed in this research: the subordination of contextual information to a platform or a system. Even if DTP data model can be a solution to most of these problems, there is no assurance that companies behind these systems will use this opportunity to give their users open and transparent access to all their metadata. It is important to study the possibilities of DTP and to collaborate in the development of a standard that fulfils the needs shown in this research.

4- Improving the methodology. We believed that the methodology used in this research is correct, focusing on three sources of information: user needs, former

solutions and the expert's opinions, in that precise order. Nevertheless, the methodology should be optimised to adapt it to the speed of the changes in the smartphone and cloud services industry. Further research should be conducted by adopting this methodology to a continually changing scenario, by creating a set of questions and tests that can be easily performed over time and by evolving from a fixed image of the current situation to the study of the evolution of the subject matter.

5- New digital frames. The presentation of new devices like GOOGLE Nest Hub and AMAZON Echo Show, that includes a screen and the possibility of accessing the user's photo collection opens a new way of presenting photo collections. This new window to the user's photo archive is related to photo frames, which have also been widely researched. However, it opens very interesting questions and possibilities. The fact that these devices are, at the same time, personal assistants, broadens even further the landscape of possibilities.

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GLOSSARY

ACDsee: ACDsee is a software developed by ACD Systems, a Canadian company specialized in photo management and editing software. Originally developed in 1994, ACDsee was a pioneering software for photo editing in pc and was among the first to include raw images support for different camera brands.

Adobe XMP: it is a file labelling technology that allows you to embed metadata into files during the content creation process. XMP support all the features included in the IPTC standard as well as EXIF. Despite having been developed by Adobe, it is an open standard that can be used freely by any developer to integrate it in their software. Since 2012 it is also an ISO standard (16684-1).

Amateur: in the context of this research, we understand amateur as an novel user of photography. That means that the user has some special interest in photography as a hobby. Amateurs use photography, and all the process involved in the photographic act, as a way to enjoy their free time. In the framework of this work it is important to differentiate the amateur user from the rest of them, as they are more prone to dedicate time and effort to any action related to photography, including photo management.

Aperture: Aperture was a professional photo editing software developed by Apple. Launched in November 2005, Aperture was aiming to compete with Adobe Photoshop Lightroom and offered professional tools to both manage and edit raw image files. In June

2014, Apple announced its plan to discontinue their photo management applications iPhoto and Aperture, in order to replace them with a new application, Photos, that was released for both iOS and MacOs platforms. The last update to Aperture was in October 2016 and it was mainly focused on facilitating the migration of images to other platforms.

Artificial Intelligence (AI): first defined by John McCarthy in 1956, when he invited a group of leading researchers from a wide range of advanced research fields to a conference around the topic. Today AI could be defined as a branch of science dealing with the challenge of making a digital computer or computer-controlled robot perform tasks commonly associated with intelligent beings. There are different levels of AI, from solving a simple task that has been programmed before, to solve complex situations that were not previously configured and where the system should take its own decisions. Both Machine Learning and computer vision are areas of research that can be classified under the umbrella of AI studies.

Big Data: it is a field work that deals with the specific necessities of capturing, managing, analysing and using big amounts of data that cannot be processed using traditional data processing software. Big data is often related to predictive analytics or user behaviour analytics, but its tools and methodologies can be used in any scenario that has to deal with a great volume of highly complex data. The term is often related to the 3Vs, the extreme *volume* of data, the wide *variety* of data types and the *velocity* at which the data must be processed. These characteristics were first identified by Gartner analyst Doug Laney in a report published in 2001 (Laney, 2001) .

Cloud: this term is used to describe a vast network of servers interconnected with different and specific uses. These servers can be used to either store and manage data, run applications, or deliver content or a service such as streaming videos, web mail, office productivity software, or social media. Users cannot access the information locally, instead they will access the server from any Internet-capable device, making the information available anywhere with internet connection.

Computer Vision: "*Computer vision* is the construction of explicit, meaningful descriptions of physical objects from images" (Ballard & Brown, 1982). Computer vision

is an interdisciplinary field that works within solutions to reach high levels of computer understanding of images and video. Machines can efficiently process images, but understanding the content of an image is way more complicated. Computer vision aims to create systems and algorithms that could match, or even surpass the human vision capabilities (Huang, 1996).

Human vision and understanding is a complex process, and so is computer vision. It includes the tasks of acquiring, processing, analysing and understanding digital images to produce data coded in numerical or symbolical information. In order to do so, the engagement of different fields, e.g. camera hardware, neuronal network design and statistics is required.

DNG: it is a file format developed and patented by Adobe and presented in September 2004. It is used for storing raw image data, it is open source and the use of the file is royalty-free for any developer. It is based on the TIFF/EP standard format and allows raw images, jpg thumbnails as well as metadata in the form of EXIF, XMP and IPTC among others. DNG format is used by smartphone manufactures to capture raw images as well as some camera manufactures like Leica and Hasselblad. Unlike most of the proprietary raw files from camera brands like Canon or Nikon, DNG files can save modifications in their metadata. This avoid the creation of sidecar files containing this metadata information.

DSLR: Digital Single Lens Reflex. This term is used to refer to digital cameras that use the structure used in traditional reflex cameras. Users can view the image created by the lens by a system composed by a retractable mirror and pentaprism. The image, instead of being captured on film is captured on a digital sensor once the mirror is up and the shutter is fired.

Exchangeable image file format (EXIF): it is a standard that specifies image and sound formats, including metadata files. Initially developed by JEITA (Japan Electronics and Information Technology Industries Association) and CIPA (Camera and Imaging Products Association) in 1998, it has been updated a couple of times (JEITA, 2016) and it is widely supported by cameras and photographic software, as well as OS. EXIF

includes information about time and locations, and camera and lens settings, both static (camera model, focal length) and dynamic (exposures time, fire of flash). It can also contain descriptions and Copyright information. EXIF standard is included in the Extensible Metadata Platform, or XMP metadata standard developed by Adobe and used in all their software (Adobe, 2019). EXIF information can be attached to many image formats like JPEG, PNG, DNG and PSD.

Face Recognition: it is a technology in some software and systems to detect and identify or verify a person from a photography, a video frame or a video source. This technology can use different methods to obtain the information from the images, but it generally works using a database of existing images of the subjects, for recognizing and creating patrons and searching other images.

Facebook: it is a social network created by Mark Zuckerberg in 2004. Facebook allows users to share text, images, videos and icons with the rest of the users that are connected in each user personal net, as well as doing it public. Facebook is the social network with the most monthly active users worldwide and the most widely used.

Feature Phone: it is the term to define a mobile phone that has no smartphone capabilities. With the popularity of smartphones it was necessary to create a term to define a mobile phone that was not a smartphone. Most of them do not have touchscreen and have very little options. Recently, a mobile OS called KaiOS introduced some simple features from smartphones, such as WhatsApp or Facebook, on new features phones like Nokia 8810. They are also called dumb phones.

Human Computer Interaction (HCI): HCI is the academic discipline that studies the way people interact with computer technology. It is an interdisciplinary field, as it is very dependent ON computing science, psychology, sociology and other analogue areas. It is also a design discipline that figures out how to create computer technology that can interact with people. HCI focuses in both software and hardware and, with the ubiquity of computer in current society, HCI is broadly expanded in many fields of design and academic research. HCI is in some way the forerunner of UX.

Information and communications technology (ICT): these are the set of technologies that allow people and organizations to use, share and store digital information. The term comes originally form IT (Information Technology) but it conveys a narrow meaning. ICT include wired and wireless networks, fixed and mobile terminals as well as all the necessaire firmware and software needed for their mutual connexion.

Infrastructure: in this research the term infrastructure is used following Risto Sarvas criteria. Sarvas defines it as "the network of devices, software, cables, protocols, screens, file formats, required to 'do' domestic and snapshot photography in the twenty-first century" (Sarvas & Frohlich, 2011). The term is adapted in this research to the field of smartphone photography and it involves all the hardware and software needed in mobile photography. it is applicable to elements located in the smartphone as well as clouds, servers and external screens.

Instagram: it is a social network born in October 2010. Instagram is mainly focused on sharing images in a timeline. Users can see the images of the people they follow organised by an algorithm. Instagram also allows to share short videos and image galleries. Together with the main timeline there is a section called "Stories" where users can share vertical 16:9 images or videos. Those images or videos are shown to the rest of the users in a sort of slideshow and are only visible during 24h. There is an option to collect and preserve for a longer time a selection of stories.

Originally presented form iOS, it was introduced for Android in 2012. The company was soon after acquired by Facebook and now it has multiple integrations with that network and their advertisement platform.

iPhone: it is a phone family developed by Apple. The first model was presented in 2007 and its main feature was their display with a big touch screen, a home button and lock and volume keys. To take advantage of the touch screen, Apple developed their own mobile OS called iOS. At the end of 2019 there were more than 23 different models of iPhone and iOS was on its 13th version.

iPhoto: it is a photo management software developed by Apple in 2002 to organise and store domestic photography in Apple computers running Mac OSX. The software was later introduced in the iLife suite that included other multimedia software as iMovie and iWeb. Since its launch until it was substituted by Photos app in 2014, it came preinstalled in all apple computers and it was the default software to manage images.

International Press Telecommunications Council (IPTC): it is a council that groups the world's major news agencies, other news providers and news industry vendors and acts as the global standards body of the news media. IPTC has created a metadata standard that includes information like description, keywords, location and other information that helps to describe the image context. It allows information to be transported with an image file, in a way that can be understood by other software and human users. Information in IPTC is organized into three categories: i) administrative, including creation date and location, instructions for the users, job identifiers and other details. ii) Descriptive, including information about the visual content. It presents a headline, caption and keywords, and it may include people, locations, companies, artwork or products shown in the image. This can be conveyed through free text or by using keywords or tags, and finally (iii) rights, with identification of the creator and Copyright information and licensing. This metadata can be attached to the image file in formats such as JPEG, DNG, PNG and TIFF or as a sidecar file in the shape of an XMP file. XMP metadata includes and supports both EXIF and IPTC metadata.

Kodak: it is the short name after which the EASTMAN KODAK COMPANY is know. Founded by George Eastman and Henry A. Strong in 1881 as the Eastman Dry Plate Company, it first introduced a camera preloaded with enough flexible film for 100 exposures. The easy use and the relative low price for the time made photography available for domestic use for the first time. KODAK rapidly became a leader in the films industry and during more than 100 years shaped the domestic photography industry. With the arrival of digital photography and after a long legal process with POLAROID, KODAK was unable to adapt their business model to the new domestic infrastructure.

Lightroom: it is a software family first introduced by Adobe in 2006. Right now, it is available for Windows, macOS, iOS, Android, and tvOS (Apple TV). It is designed for image organization and image manipulation in a non-destructive way and aimed to professionals. Lightroom allows users to manage great collections of raw images and works over a database. Lightroom enables users to organise their photos in collections and filter them using both exif and iptc metadata information. In the develop module it is possible to transform raw images in various image formats, sizes, depths and colour profiles.

Lumia Phones: In 2011 Nokia and Microsoft announced a partnership for Nokia to use Windows Phone as its main OS and Microsoft to use Nokia Maps. The new family of phones developed by Nokia with Windows Mobile was called Lumia. The first phones announced where the Nokia Lumia 710 and Nokia Lumia 800. The latter was built on the hardware of the previous Nokia N900, that used Maemo OS. After Microsoft acquired Nokia mobile phones business, Nokia Lumia line started to be called Microsoft Lumia.

Machine Learning: it is an area of computer science that uses significant amounts of data and statistical methods to give the software the ability to learn specific features (Gonzalez, 2018). The main difference between machine learning and other algorithm-based solutions is that a machine learning algorithm can learn from data without relying on rules-based programming. Machine Learning is a part of computer science inside the more generic term Artificial Intelligence (Bishop, 2006).

An example of the use of Machine Learning in the field of image recognition would be trying to recognize a dog in an image. Following the methodology previous to machine learning would mean to build a system with a set of rules that would tell the dog apart from the background. The system would look, for example, the shape of the ears, the legs, nose and the rules would relate that to a limited set of grammar rules. What Machine Learning does is, instead of giving the software a set of rules and patrons to search in images, use a significant amount of information to learn how to differentiate. To do so, programmers should take numerous images of dogs and tag them with the label "dog", and then gather several pictures without dogs and tag them as "no dog". Using artificial

neuronal networks, the system creates the essential criteria and the tools to learn how to tell dogs apart in images. Machine Learning is a way of building systems that can find patrons and data in a similar way humans would do it, but with a much greater capacity (Evans, 2017).

MMS: Multimedia Messaging Service is an industry standard that allows mobile phones to send and receive multimedia content trough wireless phone networks. MMS was built over the previous standard SMS and was first available for users in 2002 with the introduction of Sony Ericsson T68i.

Mobile Device: in the context of this research, mobile devices are considered smartphones and tablets, both running iOS, Android or Windows 10. Although the main focus is on smartphones, due to their market percent, this term allows us to introduce both categories in our research.

Network-attached storage (NAS): NAS are computer servers connected to a computer network unique design to provide access and storage to files with different levels of redundancy. NAS are file-level computer data storages, meaning that the volumes are no linked to a fix physical drive. NAS enables to create simple volumes with more than one drive, facilitating the task of backups and redundancy as well as creating a modular storage system.

In photography and multimedia NAS are particularly useful, as they allow to increase the file space and replace old drives with new bigger ones without affecting the volume containing the information. There are very affordable NAS solutions in the market with no need for programming to configure or run the systems that have open this tool to small business and freelances and there are a safe and economical alternative to cloud services.

Operative System (OS): it is a low-level system software that manages both computer hardware and software basic resources providing services for computer programs. The operative system works as an intermediary between the computer hardware and the different applications, managing inputs and outputs as well as memory allocations and peripherals. Operative systems are found in many electronic devices such

as personal computers, mobile phones and smartphones, servers and even supercomputers. OS are also presented in many new hardware families because due to the growing influence of Internet of Things (IoT).

Picasa: it is a software originally developed by Lifescape in 2002. Picasa was a multiplatform image managing tool that allowed users to see, organise, document and do basic editing on their personal images. In 2004 Google acquired Picasa and offered their service for free. Despite being a desktop software, the web version of Picasa, with the ability to share photo albums, was the predecessor of Google Photos. Google ceased support on Picasa in 2016 and in the same year Picasa Web Albums were also closed, focusing their efforts in their new service Google Photos.

Smartphone: Cambridge Dictionary defines it as "a mobile phone that can be used as a small computer and that connects to the Internet". Smartphones' main difference from featured phones comes from the fact that they have complex OS that allow the user to install third party applications, usually called apps.

Snapchat: it is a social network created in 2011. Its basic principle is that the images shared can be viewed a limited number of times and during a limited period of time. Snapchat has the option to share the images and videos privately to other user or group of users, or to post them to all Snapchat users. In words of Evan Spiegel, cofounder of Snapchat "Snapchat isn't about capturing the traditional Kodak moment. It's about communicating with the full range of human emotion — not just what appears to be pretty or perfect" (Spiegel, 2012).

Snapshot: as defined by Risto Sarvas, snapshots are the photographs created by consumer cameras. Snapshots are the domestic images that users created with their cameras with no artistic or pretentious goals and that have as a major purpose to document a personal or family moment.

Symbian OS: Symbian is a mobile OS and computing platform originally developed in 1997 by the Symbian Ltd., a partnership between Psion, Nokia, Ericsson, Motorola and Sony. Symbian OS was mainly known for being the OS of most of Nokia advance phones

during the years of most success for the company. Symbian was the first OS that allow the user to install third party apps on phones, therefore setting the birth of the smartphone. In the late years before being discontinued by Nokia, Symbian was adapted to work with touch screens. The last smartphone commercialized with Symbian was the Nokia 808 PureView in 2012.

Synology: it is a hardware and software company specialized in Network-attached storage (NAS) appliances. Synology produced a great variety of consumer and small to median size professional NAS that are very popular. The main difference from their competition is the OS of their NAS, called DiskStation, that makes configuration very simple. DiskStation also allows users to create their own cloud server, photo managing service or even mail server.

Systems: in this research the term infrastructure is used to represent the different tools for photo management that exist on mobile devices. The term was used to allow a comparison between the tools included in mobile OS, apps with specific functions around photo management and cloud and web services. Although most of those tools have very similar uses, as it will be shown in this research, the nature of each one is different. The use of the term systems allows the research to unified this.

Tags: Oxford dictionary descries tab as “a label attached to someone or something for the purpose of identification or to give other information.” In the field of photo management, tags are keywords, colours, stars or other symbol like flags, that allow the user or the system to attach extra information to an image. This enables a further search and filtering of the images in a fast and effective way.

User Experience (UX): a person's perceptions and responses that result from the use, or anticipated use of a product, system or service (Law et al, 2009). UX embraces all the aspects of the end user perceptions and responses while using a product, system or service. UX is often confused with User Interface (UI). Although the user interface is an essential part of the UX, it is focused only on the system side of the interaction, as the UX has a more comprehensive view of the interactions between user and system. The design of a UX has, therefore, to have a cross-sectional view of all the parts of the system

that implies the interaction on the user or has some consequences in it. First used by Nixon and Whiteside in 1987 (Whiteside & Wixon, 1987) it was popularised by Don Norman during his time working for APPLE.

UXD: User Experience Design is the process of designing for the user satisfaction, taking into account the users' experience as a final goal for the interaction between the user and the product. UXD are therefore, the series of techniques, tools and procedures that a design process should take into account to obtain a satisfactory UX. This set of techniques, tools and procedures varies between areas of design and even between products.

WhatsApp: it is a cross-platform messaging, voice and video service originally launched in 2009. In 2019 WhatsApp was the most popular messenger app worldwide, followed by Facebook Messenger, that actually owns WhatsApp.

WhatsApp had a very fast grow, especially in some European and south American countries with expensive SMS and MMS services, as an alternative to easily share images and text between two or more users.

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BIBLIOGRAFÍA

Ford, C., & Steinorth, K. (1988). *You Press the Button We Do the Rest: The Birth of Snapshot Photography.* London: D. Nishen in association with the National Museum of Photography, Film and Television.

Jansen, M., Van den Hoven, E., & Frohlich, D. (2014). Pearl: Living media enabled by interactive. *Personal and Ubiquitous Computing*, 1259-1275.

Aamoth, D. (2014, August 18). *First Smartphone Turns 20: Fun Facts About Simon*. Retrieved from Time Magazine: https://time.com/3137005/first-smartphone-ibm-simon/

Adle, M., & Ziglio, E. (1996). *Gazing into the oracle: The Delphi method and its application to social policy and public health.* Jessica Kingsley Publishers.

Adobe. (2019). *Extensive Metadata Platform (XMP)*. Retrieved from Adobe: https://www.adobe.com/products/xmp.html

Alakarhu, J. (2007). Image sensors and image quality in mobile phones. *Proceedings of International Image Sensor Workshop.*

Anon, J. (2015, November 9). *Amazon Photos Adds This Day Feature & Improves Album Management*. Retrieved June 1, 2016, from Android Headlines: http://www.androidheadlines.com/2015/11/amazon-photos-adds-this-day-feature-improves-album-management.html

Apple Inc. (2018, May 1). *Using HEIF or HEVC media on Apple devices*. Retrieved from Apple Support: https://support.apple.com/en-us/HT207022

Ballard, D., & Brown, C. (1982). *Computer Vision.* New Jersey: Prentice Hall.

Bandaru, K., & Patiejunas, K. (2015, May 4). *Under the hood: Facebook's cold storage system*. Retrieved from Facebook Code: https://code.fb.com/production-engineering/-under-the-hood-facebook-s-cold-storage-system-/

Banks, R., Duffield, N., Sellen, A., & Taylor, A. (2012). Memory. *Things we've learnt about*.

Barthes, R. (1977). Rhetoric of the lmage. In *Image, music, text.* London.

Bentley, F., Kaye, J. J., Shamma, D., & Guerra-Gomez , J. A. (2016). The 32 days of christmas: Understanding temporal intent in image search queries. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 5710-5714.

Bentley, F., Metcalf, C., & Harboe, G. (2006). Personal vs. Commercial Content: The Similarities. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 667-676.

Bernard, H. (1988). *Research Methods in Anthropology.* Lanham, MD: Rowman & Littlefield.

Bishop, C. (2006). *Pattern Recognition and manchine learning.* Springer.

Brandom, R. (2019, May 22). *The case against Huawei, explained*. Retrieved from The Verge: https://www.theverge.com/2019/5/22/18634401/huawei-ban-trump-case-infrastructure-fears-google-microsoft-arm-security

Brewster, S. (2015, June 3). *How Google's New Photos App Can Tell Cats From Dogs*. Retrieved from Backchannel: https://backchannel.com/how-google-s-new-photos-app-can-tell-cats-from-dogs-ffd651dfcd80#.i2blo7c5o

Broekhuijsen, M., van den Hoven, E., & Markopoulos, P. (2017). From PhotoWork to PhotoUse: exploring personal digital photo activities. *Behaviour & Information Technology*, 754–767.

Bushey, J. (2013). Web Album: Preserving the Contemporary Photographic Album. In G. Farnell , *The Photograph and The Collection: Create | Preserve | Analyze | Present* (pp. 110-142). Edinburgh: MuseumsEtc.

Bushey, J. (2016). The Archival Trustworthiness of Digital Photography in Social Media Platforms.

Byers, P. (1966). Cameras Don't Take Pictures. *Columbia University Forum, 1*, 27-31.

Castelló-Mayo, E., Mendez, R., Lopez Gomez, A., Flores, J., & Sanchez-Vila, E. (2016). Research, Development and Creativity in Ubiquitous Technologies in University: CIDUS Contribution. In Emerging Perspectives on the Mobile Content Evolution (pp. 284-321).

Caballo Ardila, D. (2006). *Fotoperiodismo y Edición.* Madrid: Editorial Universitas.

Canon. (2019). *Camera Hall*. Retrieved from Canon Camera Museum: https://global.canon/en/c-museum/series_search.html?t=camera&s=film&s2=eos&sort=old

Chalfen, R. (1987). *Snapshot versions of life.* Bowling Green, Ohio: Bowling Green State University Popular Press.

Chalfen, R. (2000). *Rihcard Chalfen Brief Biography and Academic Orientation*. Retrieved from http://www.richardchalfen.com/bio.html

Chalfen, R. (2012). *Photogaffes.* Indianapolis: Dog Ear Publishing.

Chambers, D. (2001). *Representing the family.* London: SAGE.

Chen, B. X. (2016, June 1). *Zen and the Art of Managing Smartphone Photos*. Retrieved June 2, 2016, from The New York Times: http://www.nytimes.com/2016/06/02/technology/personaltech/zen-and-the-art-of-managing-smartphone-photos.html?_r=0

Chen, C., Oakes, M., & Tait, J. (2006). Browsing Personal Images Using Episodic Memory (Time + Location). *Lecture Notes in Computer Science Advances in Information Retrieval*, 362-372.

Chesbrough, H., & Crowther, A. (2006). Chesbrough, H., & Crowther, A. K. (2006). Beyond high tech: early adopters of open innovation in other industries. *R&d Management*, 229-236.

CIPA. (2015). *Quantity of Total Shipment of DSC Comparison of 2013, 2014 and 2015.*

CIPA. (2018). *Cipa Santadards*. Retrieved from Camera & Imaging Products Association: http://www.cipa.jp/std/std-sec_e.html

CIPA. (2018). *Total Shipments of Digital Still Cameras.*

Coleman, A. (1998). *Light readings: a photography critic's writings, 1968-1978. .* Albuquerque: University of New Mexico Press.

Crabbe, L. (2013, July 15). *A history of smartphone cameras, from the Nokia 7650 to Lumia 1020*. Retrieved from DPreviw Connet: http://connect.dpreview.com/post/0640801189/smartphone-camera-history-nokia

Crabtree, A., Rodden, T., & Mariani, J. (2004). Collaborating around collections. *Proceedings of the 2004 ACM conference on Computer supported cooperative work - CSCW '04*, 396-405.

Cross, K., & Peck, J. (2010). Editorial: Special Issue on Photography. *Photographies,*, 127-138.

Data Transfer Project. (2018, July 20). *Data Transfer Project Overview and Fundamentals.* Retrieved from https://datatransferproject.dev/dtp-overview.pdf

Davis, M., King, S., Good, N., & Sarvas, R. (2004, October). From Context to Content:. *Proceedings of the 12th annual ACM international conference on Multimedia*, 188-195.

Denzin, N. (1978). *The Research Act: A Theoretical Introduction to Sociological Methods.*

Dijck, J. v. (2007). *Mediated Memories in the Digital Age.* Stanford, CA: Stanford University Press.

Drucker, S., Wong, C., Roseway, A., Glenner, S., & De Mar, S. (2004). MediaBrowser: reclaiming the shoebox. *Proceedings of the working conference on Advanced visual interfaces*, 433-436.

Durrant, A., Frohlich, D., Sellen, A., & Lyons, E. (2009). Home curation versus teenage photography: Photo displays in the family home. *International Journal of Human-Computer Studies*, 1005-1023.

Eastman Kodak Company. (2019). *George Eastman*. Retrieved from Kodak: https://www.kodak.com/ES/es/corp/aboutus/heritage/georgeeastman/default.htm

Edwards, E. (2005). Photographs and the Sound of History. *Visual Anthropology Review*, 27-46.

Elsden, C., Kirk, D. S., & Durrant, A. C. (2015, September 23). A Quantified Past: Toward Design for Remembering With Personal Informatics. *Human–Computer Interaction*, 1-40.

Ericsson. (2002). *Ericsson Anual Report 2002.* London: Ericsson Editorial Services.

Evans, B. (2015, June 15). *Mobile: It Changes Everything.* Retrieved February 09, 2016, from Andreessen Horowitz Vimeo Channel: https://vimeo.com/130722577

Evans, B. (2017, July 15). *Mobile Is Eating the World, 2016*. Retrieved from a16Z Youtube Channel: https://www.youtube.com/watch?v=3d7zZz_niTc&t=401s

Fetveit, A. (2013). The Ubiquity of Photography. In U. Ekman, *Throughout : Art and Culture Emerging with Ubiquitous Computing* (pp. 89-102). Cambridge, MA.

Fowler, G. (2016, April 27). *The Return of the Dumbphone.* Retrieved June 30, 2016, from Wall Street Journal: http://www.wsj.com/video/the-return-of-the-dumbphone/A5DF8F50-D9BD-443E-B85E-22BE942354CF.html

Fowler, G. (2018, February 2). *We've reached peak smartphone. What are Apple and Samsung going to do now?* Retrieved from The Washington Post: https://www.washingtonpost.com/news/the-switch/wp/2018/02/02/weve-reached-peak-smartphone-what-are-apple-and-samsung-going-to-do-now/?noredirect=on&utm_term=.466107a1648d

Fraga Pérez, A., & Forti Buratti, M. A. (2017, Februray). New habits in smartphones photo management. *adComunica*(13), 135-156.

Fraga, A. (2012). La tecnología PureView en el entorno profesional.

Fraga, A. (2013, Septembre). Integration of photography on Windows Phone 8 platform.

Framingham, M. (2018, February 1). *Apple Passes Samsung to Capture the Top Position in the Worldwide Smartphone Market While Overall Shipments Decline 6.3% in the Fourth Quarter, According to IDC*. Retrieved from International Data Corporation: https://www.idc.com/getdoc.jsp?containerId=prUS43548018

Freund, G. (1993). *La fotografía como documento social.* Barcelona: Gustavo Gili.

Frohlich, D., & Drazin, A. (2007). Good Intentions: Remembering through Framing Photographs in English Homes. *Ethnos*, 51-76.

Frohlich, D., Kuchinsky, A., Pering, C., Don, A., & Ariss, S. (2002). Requirements for photoware. *CSCW '02 Proceedings of the 2002 ACM conference on Computer supported cooperative work*, 166-175.

Frohlich, D., Wall, S., & Kiddle, G. (2012). Re-discovery of forgotten images in domestic photo. *Personal and Ubiquitous Computing*, 729-740.

Gartnet. (2015). *Forecast: PCs, Ultramobiles and Mobile Phones, Worldwide, 2011-2018, 4Q14 Update.* Stamford: Gartner.

Girgensohn, A., Adcock, J., Cooper, M., Foote, J., & Wilcox, L. (2003). Simplifying the Management of Large Photo Collections. In G. M. Rauterberg, *Human-Computer Interaction INTERACT '03* (pp. 196-203). Zurich: IOS Press.

Gomez, E., & Lehmuskall, A. (2016). *Digital Photography and Everyday Life: Empirical studies on material visual practices.* New York: Routledge.

Gonzalez, A. (2018). *CleverData*. Retrieved from What is Machine Learning?: https://cleverdata.io/what-is-machine-learning/

Google. (2016, August 15). *Google Photos: Free Up Space*. Retrieved from Google Australia Youtube Channel: https://www.youtube.com/watch?v=dSj6wHfYjTQ

Griffin, A. (2016, May 11). *The Independent*. Retrieved from FACEBOOK MOMENTS: FACIAL RECOGNITION APP LAUNCHED THAT ISN'T ALLOWED TO RECOGNISE PEOPLE'S FACES: https://www.independent.co.uk/life-style/gadgets-and-tech/news/facebook-moments-company-launches-facial-recognition-app-that-isn-t-allowed-to-recognise-people-s-a7023831.html

Gómez-Cruz, E. (2015). Self-Portraits and Chats: The Unofficial Story of the Selfie. In A. Lehmuskallio, & A.-K. Rastenberger, *#sanpshot, Camera amoung us* (pp. 31-32). Helsinki: The Finnish Museum of Photography.

Hänska, M. (2016, January). Networked communication and the Arab Spring: Linking broadcast and social media. *New Media & Society*.

Hadland, A., Cambell, D., & Lambert, P. (2015). *The state of news photography: The lives and livelihoods of photojournalists in the digital age.*

Hand, M. (2012). *Ubiquitous Photography.* Cambridge: Polity Press.

Hirsch, M. (1997). *Family frames: photography, narrative, and postmemory.* Cambridge, Mass.: Harvard University Press.

Hirsch, M. (2012). *Family Frames: Photography, narrative and postmemory.* London: Hardvar University Press.

Honan, M. (2015, May 28). *Google's New Photos App Is Like Gmail For Pictures*. Retrieved from BuzzFeed News: https://www.buzzfeednews.com/article/mathonan/googles-new-photos-app-is-like-gmail-for-pictures

House, N. A. (2011). Personal photography, digital technologies and the uses of the visual. *Visual Studies, 26*(2), 125-134.

Huang, T.-T. (1996). Computer Vision: Evolution and Promise.

Humphries, M. (2019, January 2). *Windows 10 Finally Becomes Most Popular Desktop OS*. Retrieved from PC Magazine: https://www.pcmag.com/news/365678/windows-10-finally-becomes-most-popular-desktop-os

IDC. (2018). *Smartphone Market Share*. Retrieved from IDC: https://www.idc.com/promo/smartphone-market-share

ImageNET. (2015, Decembre 10). *Large Scale Visual Recognition Challenge 2015 (ILSVRC2015)*. Retrieved June 1, 2016, from Image NET: http://image-net.org/challenges/LSVRC/2015/results

Ingraham, N. (2015, March 24). *Facebook officially launches nostalgia-inducing 'On This Day' feature*. Retrieved June 1, 2016, from The Verge: http://www.theverge.com/2015/3/24/8284703/facebook-on-this-day-nostalgia-recap

International Data Corporation (IDC). (2015, August). *Worldwide Quarterly Mobile Phone Tracker*. Retrieved from Smartphone OS Market Share, 2015 Q2 : http://www.idc.com/prodserv/smartphone-os-market-share.jsp

IPTC. (2018). *IPTC Photo Metadata Standard*. Retrieved from International Press Telecomunication Council: https://iptc.org/standards/photo-metadata/iptc-standard/

Jeffrey, I. (1999). *La fotografía: una breve historia.* Barcelona: Ediciones Destino.

JEITA. (2016). *JEITA CP-3451D.* JEITA.

Josh, C. (2014, Apribl 9). *Hands-On Video Of Carousel, Dropbox's Replacement For Your Camera Roll*. Retrieved from Techcrunch:

https://techcrunch.com/2014/04/09/carousel-photo-app/?_ga=2.130473743.1814297282.1534783502-744526358.1532084614

Keane, T. (2016, July 14). *Quora*. Retrieved from How bit is Google Photos team?: https://www.quora.com/How-big-is-the-Google-Photos-team

Kelm, S. (2016). The Quest for Permanence and Impermanence: A Comparison of Traditional and Social Media Photo Albums. *UBC iSchool Student Journal*.

Kim, J., & Zimmerman, J. (2006). Cherish: Smart Digital Photo Frames. (A. Press, Ed.) *CHI '06 extended abstracts on Human factors in computing systems - CHI EA '06*, 953-958.

Kindberg, T., Spasojevic, M., Fleck, R., & Sellen, A. (2005). The Ubiquitous Camera: An In-Depth Study of Camera Phone Use. *IEEE Pervasive Comput. IEEE Pervasive Computing*, 42-50.

Kirk, D. S., Sellen, A. J., Rother, C., & Wood, K. R. (2006). Understanding photowork. *Proceedings of the SIGCHI conference on Human Factors in computing systems - CHI '06* (pp. 761-770). New York: ACM Press.

Krizhevsky, A., Sutskever, I., & E. Hinton, G. (2012). ImageNet Classification with Deep Convolutional Neural Networks. *Advances in Neural Information Processing Systems 25* (pp. 1097--1105). Lake Tahoe: Curran Associates, Inc.

Kuhn, A. (2002). *Family secrets: acts of memory and imagination.* London: Verso.

Laney , D. (2001). *3D Data Management: Controling Data Volume, Velocity and Variety.* Meta Group.

Langford, M. (2001). *Suspended conversations the afterlife of memory in photographic albums.* Montreal, Que.: McGill-Queen's University Press.

Langford, M. (2006). Speaking the Album. In A. Kuhn, *Locating memory: photographic acts* (pp. 223-246). New York: Berghahn Books.

Law, E.-C., Roto, V., Hassenzahl, M., Vermeeren, A., & Kort, J. (2009). Understanding, Scoping and Defining User eXperience: A Survey Approach. *Conference: Proceedings of the 27th International Conference on Human Factors in Computing Systems, CHI 2009*, (pp. 719-728). Boston.

Le Moignan, E., Lawson, S., Rowland, D., Mahoney, J., & Briggs, P. (2017). Has Instagram Fundamentally Altered the'Family Snapshot'? *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 4935-4947.

Ledo A., M. (1995). *Documentalismo fotográfico contemporáneo: da inocencia á lucidez.* Vigo: Edicións Xerais de Galicia.

Lehmuskallio, A. (2015). Photographs That Feel Good! On Digital Photography and Modeling Techniques. In A. Lehmuskallio, & A.-K. Rastenberger, *#snapshot* (pp. 41-44). Helsinki: The Finnish Museum of Photography.

Lindley, S., Durrant, A., Kirk, D., & Taylor, A. (2009). Collocated social practices surrounding photos. *Proceeding of the twenty-sixth annual CHI conference extended abstracts on Human factors in computing systems - CHI '08*, 995-1004.

Lowell MacDonald, R. (2015). "Going Back in a Heartbeat": Collective memory and the online circulation of family photographs. *photographies*, 23-42.

Lury, C. (1998). *Prosthetic Culture: Photography, Memory and Identity.* London: Routledge.

MacDonald, R. (2015). "Going Back in a Heartbeat": Collective memory and the online circulation of family photographs. *Photographies*, 23-42.

Marzal, J., & Soler, M. (2011). Hábitos de consumo y usos de la fotografía en la era digital entre estudiantes de comunicación. *Comunicar*, 109-116.

McCormick, R. (2014, December 17). *Dropbox's Carousel adds Flashback photos to help you relive old memories*. Retrieved June 1, 2016, from The Verge: http://www.theverge.com/2014/12/17/7407503/dropboxs-carousel-adds-flashback-photos-to-help-you-relive-old

Mendez, R., Flores, J., Castelló-Mayo, E., & Arens, R. (2016). Preliminary evaluation of the Kinect V2 sensor for its use in virtual TV sets with natural interaction. Interacción '16, XVII International Conference on Human Computer Interaction. Salamanca: ACM Proceeding.

Mendez, R., Flores, J., Castelló-Mayo, E., & R.R. Viqueira, J. (2017). Natural interaction in virtual TV sets through the synergistic operation of low-cost sensors. Universal Access in the Information Society.

Mendez, R., Flores, J., Castelló-Mayo, E., Arenas, R., & Villaroya, S. (2015). Sensorización avanzada para estudios virtuales de televisión. VI Congreso de TV Digital Interactiva - IV Jornadas Iberoamericanas de Aplicaciones y Usabilidad de la TVDi. Palma de Mallorca.

Miller, A., & Edwards, W. (2007). Give and Take: A Study of Consumer Photo-Sharing. *CHI'07 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, (pp. 347 - 356).

Mordvintsev, A., Olah, C., & Tyka, M. (2015, June 17). *Inceptionism: Going Deeper into Neural Networks*. Retrieved May 23, 2016, from Google Research Blog: http://googleresearch.blogspot.pt/2015/06/inceptionism-going-deeper-into-neural.html

Moreau, E. (2016, September 8). *What Happens to Your Online Accounts When You Die?* Retrieved September 22, 2016, from About.com: http://webtrends.about.com/od/Social-Media-Evolution/fl/What-Happens-to-Your-Online-Accounts-When-You-Die.htm?utm_content=7204465&utm_medium=email&utm_source=cn_nl&utm_campaign=todaysl&utm_term=

Neustaedter, C., & Fedorovskaya, E. (2009). Understanding and improving flow in digital photo ecosystems. In A. Gooch, *GI '09 Proceedings of Graphics Interface 2009* (pp. 191-198). Missisauga, Ont.: Canadian Information Processing Society.

Newton, C. (2015, April 29). *ALL-TIME GREATEST ALBUM*. Retrieved June 16, 2016, from The Verge: http://www.theverge.com/2015/4/29/8467289/cloud-photo-storage-comparison-dropbox-icloud-flickr-onedrive-free

Nokia. (2002). *Nokia 7650, User Guide.* Helsinki: Nokia.

Odom, W., Selby, M., Sellen, A., Kirk, D., Banks, R., & Regan, T. (2012). Photobox: On the Design of a Slow Technology. *Proceedings of the Designing Interactive Systems Conference on - DIS '12*, 665-668.

Odom, W., Sellen, A., Banks, R., Kirk, D., Regan, T., Selby, M., . . . Zimmerman, J. (2014). Designing for slowness, anticipation and re-visitation. *Proceedings of*

the 32nd annual ACM conference on Human factors in computing systems - CHI '14, 1961-1970.

Odom, W., Zimmerman, J., Forlizzi, J., López Higuera, A., Marchitto, M., Cañas, J., . . . Moore, H. (2013). Fragmentation and Transition: Understanding Perceptions of Virtual Possessions among Young Adults in South Korea, Spain and the United States. *Proceedings of SIGCHI Conference on Human Factors in Computing Systems*, 1833-1842.

Ofcom. (2015). *The Communications Market Report.* London: Ofcom.

Olanoff, D. (2015, August 20). *Google Photos Introduces "Rediscover This Day" To Help You Reminisce*. Retrieved June 1 2016, from TechCruch: http://techcrunch.com/2015/08/20/google-photos-introduces-rediscover-this-day-to-help-you-reminisce/

Olanoff, D. (2015, August 20). *TechCrunch*. Retrieved from Google Photos Introduces "Rediscover This Day" To Help You Reminisce: https://techcrunch.com/2015/08/20/google-photos-introduces-rediscover-this-day-to-help-you-reminisce/

Ortiz García, C. (2006). Una lectura antropológica de la fotografía familiar. *Cuartas Jornadas Imagen, Cultura y Tecnología* (pp. 153-166). Editorial Archiviana : Universidad Carlos III.

Petrelli, D., Bowen, S., & Whittaker, S. (2014). Photo mementos: Designing digital media to represent ourselves at home. *International Journal of Human-Computer Studies*, 320-336.

Petrelli, D., Whittaker, S., & Brockmeier, J. (2008). Autotopography: What can Physical Mementos tell us about Digital Memories? *In Proceedings of the ACM Conference on Human Factors in*, 53–62.

Pole, C., & Lampard, R. (2002). *Practical social investigation: qualitative and quantitative methods in social research.* Harlow, England: Prentice Hall.

Popper, B. (2015, July 29). *Why Microsoft is giving away Windows 10 for free*. Retrieved May 24, 2016, from The Verge: http://www.theverge.com/2015/7/29/9066749/microsoft-windows-10-office-app-free-upgrade-model

Popular Science. (1999, December). 1999 Best of what's new. *Popular Science*, 60.

Prieto, P. (2010). Family Photography as a phatic construction. *Networking Knowledge: Journal of the MeCCSA Postgraduate Network,* .

Prieto, P. (2016). Transnational (Dis)affect in the Digital Age: Photographic Practices of Irish-Spanish Families Living in Ireland. *PhD thesis, National University of Ireland*.

Prieto, P. (2017). Visual Mediations, Affordances and Social Capital. *Mebrana 4.* Ljubljana: Membrana

Rams, D. (2009, December 1). *Dieter Rams: Less and More Interview*. Retrieved from Gestalten Vimeo Channel: https://vimeo.com/7917568

Recon Analytics. (2015, February 10). *2014 US Mobile Phone sales fall by 15% and handset replacement cycle lengthens to historic high*. Retrieved February 09, 2016, from http://reconanalytics.com/: http://reconanalytics.com/2015/02/2014-us-mobile-phone-sales-fall-by-15-and-handset-replacement-cycle-lengthens-to-historic-high/

Rodden, K., & Kenneth, W. (2003). How do people manage their digital photographs? *Proceedings of the conference on Human factors in computing systems - CHI '03*.

Sandbye, M. (2014). *Looking at the Family Photo Album: A resumed theoretical discussion of why and how.* Copenhagen, Denmark: Journal of Aesthetics and Culture.

Sarvas, R. (2006, 6 12). Designing User-Centric Metadata For Digital Snapshot Photography. Helsinki.

Sarvas, R. (2014). Less Pictures, More Metadata: The Story of Snapshots in the Digital Age. In A. Lehmuskallio, *#snapshot* (pp. 45 - 52). Helsinki: The Finnish Museum of Photography.

Sarvas, R., & Frohlich, D. (2011). *From snapshots to social media: The changing picture of domestic photography.* New York: Springer.

Seok, J.-m., Kim, D.-j., Lim, Y.-k., Nam, T.-j., Lee, M.-h., Lee, Y., . . . Moore, H. (2013). Understanding the Curation Activities of Creating Personal and Social

Meanings for Virtual Possessions. *Proceedings of 5th International Congress of International Association of Societies of Design Research, IASDR '13.* Tokio.

Shoebox App. (2019, June 2). *Shoebox*. Retrieved from https://shoeboxapp.com/

Shove, E. (2003). Converging Conventions of Comfort, Cleanliness and Convenience. *Journal of Consumer Policy*, 395–418.

Siciliano, R. (2012, February 15). *Almost 5% of Smartphones Lost Every Year*. Retrieved May 20, 2016, from McAfee Blog Central: https://blogs.mcafee.com/consumer/almost-5-of-smartphones-lost-every-year/

Silverstone, R. (2007). *Media and morality: On the rise of the mediapolis.* John Wiley & Sons.

Slater, D. (1991). Consuming Kodak. In J. Spence, & P. Holland, *Family Sanps* (pp. 49-59). London: Virago Press.

Sontag, S. (1973). *On Photography.* New York: Delta.

Spence, J. (1991). *Family snaps: the meaning of domestic photography.* London: Virago.

Spiegel, E. (2012). *Let's chat.* Retrieved from Snap Inc. News: https://www.snap.com/en-US/news/

Stevens, M., Abowd, G., Truong, K., & Vollmer, F. (2003). Getting into the Living Memory Box: Family archives & holistic design. *Personal and Ubiquitous Computing*, 210-216.

Szegedy, C., Liu, W., Jia, Y., Sermanet, P., Reed, S., Anguelov, D., . . . Rabinovich, A. (2015). Going deeper with convolutions. *2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*.

Timehop. (2018). *Timehoop*. Retrieved from https://timehop.com

Titlow, J. P. (2014, November 3). *How Flickr Is Learning To See What's In Your Photos*. Retrieved June 1, 2016, from Fast Company: http://www.fastcompany.com/3037882/how-flickrs-deep-learning-algorithms-see-whats-in-your-photos

Toghethera. (2016, July 4). *Togethera Medium site*. Retrieved from https://medium.com/@Togethera_app/togethera-is-shutting-down-9011dc519728

Tsurumi, Y., & Tsurumi, H. (1999). Fujifilm-Kodak Duopolistic Competition in Japan and the United States. *Journal of International Business Studies*, 813 - 830.

Van Dijck, J. (2008). Digital photography: communication, identity, memory. *Visual Communication*, 57-76.

Van House, N., & Chulchill, E. (2008). Technologies of memory: Key issues and critical perspectives. *Memory Studies*, 295-310.

Van House, N., Davis, M., Ames, M., Finn, M., & Viswanathan, V. (2005). The uses of personal networked digital imaging. *CHI '05 extended abstracts on Human factors in computing systems - CHI '05*, 1853-1856.

Vincent, J. (2015, October 13). *Facebook lets you filter bad memories out of your nostalgia*. Retrieved June 3, 2016, from The Verge: http://www.theverge.com/2015/10/13/9518069/facebook-on-this-day-memory-filter

Warrem, T. (2015, February 25). *Why is Nokia making Android phones?* Retrieved from The Verge: https://www.theverge.com/2014/2/25/5445150/why-is-nokia-making-android-phones

Warren, T. (2017, Octover 9). *Microsoft finally admits Windows Phone is dead.* Retrieved from The Verge: https://www.theverge.com/2017/10/9/16446280/microsoft-finally-admits-windows-phone-is-dead

Welch, C. (2016, July 5). *The 16GB iPhone may finally be going away soon*. Retrieved from The Verge: https://www.theverge.com/2016/7/5/12100944/iphone-7-16-gb-32-gb-storage-option-apple

Welch, C. (2019, June 12). *Google is ending integration between Google Photos and Drive because apparently it's too confusing*. Retrieved from The Verge: https://www.theverge.com/2019/6/12/18662946/google-photos-drive-ending-integration-syncing

Wells, L. (2015). *Photography: a critical introduction.* London: Routledge.

WhatsApp. (2019). *About WhatsApp*. Retrieved from WhatsApp: https://www.whatsapp.com/about/

Whiteside, J., & Wixon, D. (1987). The Dialectic of Usability Engineering. In H.-J. BULLINGER, & B. SHACKEL, *Human–Computer Interaction–INTERACT '87* (pp. 17-20). Stuttgart: Elseviver.

Whittaker, S., Bergman, O., & Clough, P. (2009). Easy on that trigger dad: a study of long term family photo retrieval. *Pers Ubiquit Comput Personal and Ubiquitous Computing*, 31-43.

Wigoder, M. (2002). History Begins at Home: Photography versus Memory in Siegfried Kracauer's and Roland Barthes' Writings on Photography. *Theory and Criticism*, 19-58.

Yee, J. (2017). The researcherly designer/the designerly researcher. In L. Vaughan, *Practice-based Design Research.* Bloomsbury.

Zürn, X., Damen, K., van Leiden, F., Broekhuijsen, M., & Markopoulos, P. (2018). Photo Curation Practices on Smartphones. *Advances in Computer Entertainment Technology Lecture Notes in Computer Science*, 406-414.

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CHAPTER 8 ONOMASTIC INDEX

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CHAPTER 9 ANNEXES

9.1. INTERVIEWS

9.1.1. Juha Alakarhu

07/12/2015. Microsoft House. Helsinki.

Lots of users said they do not have time to watch their pictures, and there's no physical album you can see and remember to check. Should the system invite the user to remember to see the photos? And should that be a moment to edit and create the album?

I think your problem is extremely valid. I was a photographer, and I am still are as a hobby and I really enjoy those moments when we took the photo album and I have friend, and that was really bringing people together and focusing on the photos. And I think that one of the biggest problems on the modern photo is that you have so many photos, when you are watching more than 100 photos is getting really boring and you do not have that kind of limit. With albums or slides you have a limit of what you can show. I think there's a need to be a system that need to bring you back that experience.

You can also think the traditional photo album has been replaced by things we didn't have early, like FACEBOOK. When I put a photo on FACEBOOK, my friends will see it, but also that interaction with the photo is more superficial when you just have "Like" as your input or comments like "Wonderful photo", It's not really like a proper interaction when you show it to someone.

Should we have a trigger to activate that remember?

The trigger is missing. When you see your photo album in your bookshelf, it's "hey, let's take that". ONEDRIVE is now sending your recap from this week, it doesn't go back to 10 years or 5 years, is just your best photos of that week. It would be a good idea to remind the user.

It's also interesting to know if the computer is generating content is it going to feel as personal as the staff you have put to your photo album.

Should the system use the same time to remember you to filter some of the images?

Not sure if everything is so important. This weekend I was browsing really old photos I don't have yet in Lightroom. I was thinking in some system that could generate me an album from those pictures, and today the album looks like this, and tomorrow if I look at the album from the same time it would show me different photos every time. I don't know If it would be annoying or fun. But you need to be able to rank your photos.

We can know who is in the picture. Should we know who took the picture? The user can control who sees the pictures most of the time, and now even who is in the picture, but has no data about who made that picture.

When I have photos of friend I put them to folders, organized by name. I don't use that feature so much when I'm browsing the photos. I think there's a difference when I show the photos, do I show all the photos or just the ones I have captured myself. I sometimes give my camera to someone and would be still nice to know that that picture was taken by my wife rather than me.

Now that the phone knows who is its owner, should that info be in the metadata of the picture?

It's actually nice that when you are browsing your photos you are actually have all that content coming, but you'd still considering other people photos different because, for example, I don't want to edit them. But definitively is value to have some metadata or some way to tell this image was taken by some person, I think that makes a look of sense. I think there are opportunities, but I don't know exactly what the best way would be.

Photos used to be taken in special events where people carried a camera, now that we have the camera with us all the time, we take photos all the time. It's the "event" system to organise pictures dead?

Yes. In my personal way I'm organizing all my content by month and then I just have keywords for some events. I might have 20 different events per year but basically everything is by month and year. If you are having some event with your friends it's nice that you can take those photos "Hey let's go to see that photos", but generally when I'm showing my virtual photo album to my friends, I'm just browsing everything.

Event is a caption or label, but it's not the root of the organization.

Should the professional way of working, with captions and labels move to the consumers?

Lightroom is nice way to edit photos but the best value to me is that everything is organise. You can put all your photos to one folder, and they are still organise, and you can rank them by time and year. Making that kind of system available to consumer would be really attractive.

The user just wants to take pictures. There are two kind of users, the ones that like archiving and some people who never have time for it, but eventually, whether you have archive or not the question that people might ask is "show me the pictures from last summer" and it has to work, or "show me the pictures 10 years ago when we went to Austria, I don't remember exactly the year" and it somehow bring it.

In the beginning you don't need the archiving. Cameras can capture the location and the people who are in the picture and based on the already existing metadata if you have very clever algorithms you can be able to ask "show me the best pictures of that summer"

You can now develop a raw file from 10 years ago and have much better results. Shouldn't the system work similar, separating data from the process? Do we need new standards for that?

I think that's already happening, If I have my Lightroom with the face recognition feature so I can now to my old files and basically recognise those faces. That is very natural thing, when systems or intelligence evolve it would also cover you back, and the archiving is kind of something that is not happening during the capture time but more like an analysis.

I'm wondering what are the things that need to be archived during the captures time and there are not so many, almost everything you can capture from the photo. Maybe just the photographer who is behind the scene is missing.

Should a system collect the information from capture time and include the process metadata on the file (example, this is my friend Elena, and this is Yosemite in 2013 summer) or should that process be made in the moment of the reading of the file?

I think those systems would coexist somehow, the metadata can give you some hints and then the review system can provide more. My natural view is that keep some information, you can keep some metadata and you can keep the context to the photos themselves, but then later on, you would have even more clever things happening. Your kind of need them both

For that we need metadata standards: Can we considered IPTC and EXIF standards?

Exif enables you to do whatever you like, but all suppliers are using it differently, and the same for IPTC. Your comment early regarding to FACEBOOK, if there is a context

where this picture was taking by my friend in FACEBOOK, when I capture the photo that information can be in that photo and can be used later on in the viewing experience. But if every supplier is having different way of telling the same thing, them is not working, you need standards. Also, would be interesting to see what kind of information you actually need in the metadata from the context and the human part. If you are friend with someone in FACEBOOK now doesn't mean you are going to be friends in a couple of years, that information that you put on the file is static, but the viewing experience know the context better.

The whole thing of sharing images is still very immature, if I think about my friends on FACEBOOK, I'm sure they have lots of photos that are interesting to me and I would love to go to their albums and browse and see something interesting. I would click in the album and I will be flowing to another story in somebody else album. But the problem is that photo albums are also private, I don't want people to go to my album and see everything. But somehow the social media and friend networks, the way you captured images is a problem nobody have solved yet, because you share some kind of photos but, the photos that my friends are sharing in FACEBOOK are probably the ones I don't want to see, because I want to see the ones where I'm in and I'm doing something. And I can ask my friends why you don't share the pictures with me, but at the end they don't do it. Somehow getting access to interesting photos of your network is very difficult.

When you are sharing in FACEBOOK the problem is that if you share with all your friends a picture of my sister maybe my sister doesn't want to share that picture with everybody, maybe she just wants to keep it for herself. In FACEBOOK or INSTAGRAM when you are sharing it means that I'm telling something to everybody and everybody else wants me to tell a story about themselves that they would have in their how album. It's a different kind of need, a different kind of perspective.

In the late 80's an average collection of images was 3.000, in 2006 nearly 5.000, now is probably much more. Will the number continue growing? Or just the size or the weigh? What goes faster?

I just count it and I take 30.000 a year, this means one every 15m. I think that the number of photos you are taking is not increasing much more before the recording become something that you are recording all the time, and I'm not sure if that is any more like... And that's actually quite interesting dilemma as well, what is going to happened with these devices that can record whatever you are doing all the time, and you are removing the active photographer and you are only depending on the staff you are working on, that would make the story, not the photographer. As long as the captures experience is like this, that you take the camera and you hold it, I don't think that people can take more than 30.000 pictures of family photos. But of course, things can change if it's become a wearable.

And then the size and the weigh, I'm sure they will increase but I don't think there's a dramatic increase. Of course, now you have 4K monitor and maybe the 4K video is something that would significantly change the picture of how big is. If you are recording 4K video all the time that become an increase. But again, if what you are doing is like this (holding a phone like a camera) It comes with limits, because you need to eat and sleep and do some work, so it's not only taken pictures. Of course, if it's going to be a device that would record 4K video of everything that you do in your life is going to be a big file.

But file space is still a problem for the customer.

It's hard to me to see that problem, because if you are shooting jpg it takes like 5MB, and you can buy a hard disk for the price of a bottle of beer. Price of space is so cheap, and there's cloud which is basically becoming bigger and bigger. I understand that in some developing countries the space can be a real problem. But if you have a very well cloud system why would become a problem. As long as we take photos like this (holding a phone), when we start taking photos all the time, recording everything then it will become a problem. In the other hand, if you record everything, then is also predictable, you will probably know that per day you will generate this amount of data, you are basically recording everything. In that case you just need to develop some way of not storing everything.

Machines have learned to read and to understand, we have Cortana, and sometimes even Siri, as an example. In image, machines are nearly learning to read, but does they really understand?

Machines don't see all the value that you have in those specific images, "this is the last pictures of my dog", How would the machine know it has so wonderful value, it's just a picture of a dog. Of course, those algorithms can become much cleverer. I imagine there is a lot of research in how to know if this image is important to you, I'm sure there is some machine learning that will teach what kind of pictures people would generally prefer for the image quality point of view, but for the content point of view it's hard.

The machine can do basic things quite well, like all the pictures of my daughter are very valuable for me, but it doesn't know the deeper content. When we move from Seattle to Finland, I took some pictures from the aircraft, and those pictures are valuable for me because they remind me that was the time when we move, but you almost need to be the person to know all that contest.

But those images have that importance for you but it can even have slightly different importance for your couple, and in the future it will be totally different view for your daughter that probably don't remember well that part. So, the paper of the machine will be creating a base for the work you have to do yourself.

Yes, of course. Is the process of finding the best pictures part of making it personal? If you are in a very extreme scenario and you have a camera that is recording everything in your life, and then you have a machine that is selecting the pictures that it will share to you, you have basically removed the photographer and the selector of the content, the human becomes really, really passive. And probably for some people that is the vision: we shouldn't be bother by this device. Some people think that if we are sitting here and I would like to take a photo of you, this camera puts something between you and me and is preventing me to interact with you, so this should be removed, and the same thing for the process of showing the pictures to you. But I think there is always this part of how creative you are and how much you are saving the memories.

There are new ways of saving images, Rich Capture, Living Images, Live Photos, Dynamic Flash, etc. Is this safe for the user? Is the industry ready to create or adapt to a standard for those images, or is the industry racing to create one? Do we need standards for that?

Yes, definitely, like jpg. The living images we are now storing it in the jpg, in the metadata, but is not a standard way, is the way we did it, and MICROSOFT photos will understand, but if you take those photos to other ecosystem wouldn't work. So, the whole question of what you can save to a jpg and how is interpreted it requires standards.

But the big problem is that the use cases are so different. If you think in action shots where you take bunch of pictures and then these living images or some rich images where you have high dynamic range, they all store more than one jpg, but the user cases are completely different. So, can the standard be flexible enough to take all possible user cases in account and always know which one is? What is the innovation left if the standard defines 5 different ways of using it? "this is all you can do" We in Microsoft, and everybody, want to develop all the possible uses, and the standards will be lagging behind.

But maybe will be some basic use cases that we have now, and eventually we will kind of merge then into those 5 core use cases and those will be standardized. But that would take some time. Jpg and the containers for video, it's difficult to stay in those containers where you have just one static file and one static video. It's curious that people still using Gif just because is animated.

9.1.2. Risto Sarvas

10/12/2015. Futurice main office. Helsinki.

How will these generations shape the practices of domestic photography as they grow older? Will they, as we have suggested, have less interest in photographs as memories and value the social interaction and identity building functions more? In our survey, one of the most common comments is: "I do not have time for the album" Do we have less time o do we care less?

There's a good question what you mean by "do we care about photography". One of the big discussions it always comes up is if the individual value of a photograph has it changed, and I think yes, it has, just by the fact that we produce so many of them, so if you look at the individual photo, the value of it is less. So maybe in that sense people care less about photos.

But then again, because we create so many photos, you get new paradigm of thinking. Are not individual photos, but we started creating things like photo streams. Especially if you look at young people who don't have the legacy way of thinking on individual photos as much. How do they treat them? do they treat them like this constant flow of pictures, where the value of an individual photo changes? It's always part of this ongoing stream that is alive, that you take your photos and always look what's new, it's like a news stream, rather than individual photos that are tangible or physical. Then of course, what do you care less?

I think individual photos will have an impact in our lives, personal photos and public photos, definitely. If you look at the refugee crises in Europe some of the photos of the small boy drown, it's an individual photo that has a huge impact emotionally and politically as well. And we probably all have photos in our phones, individual photos that have some value.

It's extremely complex thing, because it opens all that things: caring about photos. Caring, you care for older people in a way that you also help them or do something for them.

Maybe we are working in something that people don't care.

Yesterday when I was flying from London back to Helsinki there where to young girls, around 18 years old next to me and they were looking at the photos of their trip to London, so you can't say they don't care about those photos, but they are doing in a very different way than probably previous generations did. So, when I was listening to you about your approach to all this, I was wondering what you actually try to. rather than looking at the technology and the applications of photos. Because I think the bigger change is actually looking at generations of people, because the differences are really really different from them. There is no one single photography, it changes enormously from different generations, and that is really interesting. And that's what you see happening. When you look at that deal whit photos nowadays, like SNAPCHAT, it's obviously for certain generation or, FACEBOOK is becoming for people older, in their thirties.

It's fragmented a loot, photography, as a culture, is fragmented a loot into these sub-cultures

Each member of the family controls his camera and has her photo flow. Is there space for a family photo album? In that case, who should curate it? Who choose what is public and what private?

I think that there is need for a family album, because then you ask why do people do family albums, and then the answer is, especially in parents, they want to create a history of childhood that is nostalgic in a sense that is positive and it's a selection of events. For example, I personally do, for every Christmas, I create a photo book. It's a lot of work, but I've done it now for almost 8, 9 years, so I have from 2006 every year a photo book, and now I can definitively see the value of taking an old picture. And then my children like to look at those photo books as well. I do believe that people still have, people want

to create stories. And I guess it has a lot to do with parent, it's a lot about the emotions of being a parent and trying to capture those special moments in the child's life, because kids grow so fast, so it tries to somehow, not to stop the growth but at least, somehow at least have something that you can go back and "Oh!, when she was three years old and she was like this and now five and she was like that". And I think there's still a need for that. But that's again the parents, then again, the children, what is the user of family albums to children. Well know that I give them to them and the saw old photos, they do kind of like them, they do like to see themselves like babies. But this is again that family album I'm talking about is looking into the past, which is of course the core of traditional family album, it's looking into the past. As the family albums is WHATSAPP now. Look at this WHATSAPP, this is couple of my friends (showing his phone), looks like an album doesn't it? But is not about the past, it's about the present. Here is my parent's and my sister, who lives in Norway, It's a family album, but is not in the past, is in the present.

So again, you can't really think in the concept of family album. But I would definitely go into the actual thinking of what's the goal of traditional family album and how does it goes into this.

In the traditional family album, there was also a "family camera". Now that the phone is the main camera, every member of the family has his how camera, so we do not have any central point where all the family pictures are. Maybe only WHATSAPP groups.

Yes, this is true.

You talked about the album, that we are still using 100 years old technology to fill that space of memory.

There is something about tangibility, but also for me, I believe in paper. But that's why I'm using a book. What you just talked now is the concept of an infrastructure, and we look as personal photography as interacting whit an infrastructure, meaning a network of devices. Then there's a photo infrastructure and then photographic devices, because as you just describe, there are servers, clouds, laptop, phones, digital camera, paper photo

albums, so it is kind of this huge infrastructure of doing photography, and that's the interesting thing. And then you decided to take the app and make a book out of the mobile phone and that is spinning things. So, there's no more single truth, as you said, because everything is decentralized, more or less, and fragmented.

Richard Chalfen said that we are documenting just 1% of our life. Now that we take more photos, are we documenting more moments of our life? Or we just have more photos of the same moments?

I think is kind of obvious that we are documenting much more just if you look at the amount of pictures. But then again there is this discussion that people are critical that we document our lives and then we forget to live the moment. I think we are documenting more, but then again, the big change that we have in the book as well is that in the KODAK era, the past was really strong and really emphasised, the past and memories and building personal histories. But now the emphasis has shifted into the present, that is all about what are friends doing now, it's all about what is happening now. And these technologies don't necessarily help you build your past for memory or documentation.

Whit social network is now more about identity and communication that memory.

And then it goes to the question of audiences, because you are building a certain identity to certain audiences, the hole Erving Goffman school of thinking, that is all about performance, our social interactions are performances, that this is kind of a front stage, I have a certain role now, in this interaction you have a certain role, and then I go home and I'm a husband and facer and not any more a researcher. Usually here I'm not a researcher, I'm a consultant. So, it all depended on the audiences, so you can definitely take that angle into looking at this mobile app. And then the funny thing is, this people don't know exactly how his audience is, they have a perception. You might have 500 people following you on INSTAGRAM, you don't really know who they are, but you have a perception and then it becomes interesting, so what kind of identity you build to this audience that you don't really know about.

And then it goes into the whole big question about family album and is that the audience play a big role. And with different apps you can reach different audiences. So, if I do the paper photo book, I do have a certain audience in my mind, and just like old family albums I can pretty much control de audience as well, and that's why I make it look like it is. But again, if I have to make a photobook for my collages here, then it would be different, because is a different audience again.

But somehow it looks like the audience of the family album has been put into de last place in the raw.

KODAK made the path of what we should photograph and how. Who is drawing now those guidelines? Why are we doing selfies? Mobile manufactures, Social Networks or it's outside the industry?

Of course is not as simple. After doing that research and writing about KODAK , I was starting thinking that maybe KODAK was an anomaly, it was actually really strange that KODAK was so dominant, usually doesn't go like that. If you look at now, there is FACEBOOK, INSTAGRAM, SNAPCHAT, but that's already three, not one.

I fully believe that, and one of the points of the book is that we should look at the industry and see what are the business motivations on the industry. Because KODAK has business motivations and that why it kind of shaped the culture this way, the culture did exist before KODAK , as we show in the book, identity, togetherness, etc., but it shaped it into a certain direction, and emphasized building a past, a nostalgic past, because it went well with the business model.

So now we see that FACEBOOK, GOOGLE, INSTAGRAM, and what is their business model? What happening to INSTAGRAM this fall? Advertisements. So, one of the things about advertisements is that you what the people to pick the phone and look at things, as often as possible. That's really good for advertisement. You get a channel that people constantly use, and you can put advertisements in the middle. To put it very simply. So definitely that's driving, so when they made design decisions "should we make it this or that way" they probably going to do it so "we are not going to print photos, we are going

to try to attract people to pick their phone and see what's new with my friends", and it goes with the business model quite well. Advertisement business model is driving the future. But then you have also the devices manufactures.

For example, NOKIA was advertising a phone with a frontal camera that "can fit 4 people in a selfie". Who came before the need for that technology ore the technology itself.

I think is a chicken-egg problem, or no problem, but is going bouncing back and forward seeing what actually can become a trend and then is more stable.

It's been really interesting form me in the book to discover the point of view of the industry.

Actually If you go to the academic part, HDI (Human-Data Interaction) doesn't do it, they don't bring the industrial point of view, and also a lot of social science. In photography, they study photographs and family albums, but they hardly ever bring in the business part of it.

Photo talk discussion around screen-based photo curation. 10 years ago, wasn't really working, how do you see it now?

I don't know but, people of course talk about the photos, that's one way of using them, and you could ask them what do they talk about the photos. And again, I remember the young girl sitting next to me on the airplane looking at their photos and talking about them. And they have some kind of application where they have different photos and they were really fun. I'm not sure if they were theirs own photos. But of course, photos are talk about. Because there is a public discussion, on FACEBOOK for example. Yes, a lot of this goes into the medium. Because it's where its posted. If I post a photo on FACEBOOK, then de discussion will happen there. But of course, isn't as necessarily rich as is a face to face. I don't have any definitely answer, I'm just remembering a lot of people having

anecdotes that sometimes people do actually do that, we seat and talk face to face, sometimes photos are a good excuse to talking face to face.

Of course, there's photo talk, but then again you can be very critical, is it photo talk or is just talk that include photos. There's text, there's video, there's photos and there's something else, advertisements.

The TV is the biggest screen in most of the cases. What role do you think it has on the photo-talk and discussion and how important do you think is the connection between devices and secondary screens.

I'm not sure. In our family we don't use the TV very much to look at photos. But for example, here we used screens quite a lot to look at photos, but of course what we look is powerpoint presentations. So, in a meeting room is extremely important, it's a really important screen everybody looks at, it's a way to communicate. But I don't really know if that happens in a domestic content

As families spend a lot of time in front of a TV, should we offer them this service to see the photos?

But do families look at TVs? Not that much anymore. I mean, the kids have their how screens, they might be in their room looking at Netflix, and then one of the kids is playing PlayStation on TV, I'm reading news form phone.

But then again is, how much can we generalise about photography, it's so fragmented into generations and cultures and geographical locations.

Rogues galleries had the role of "remembering to remember". Do we need some kind of "digital rogue galleries" or some trigger to remember us to check our pictures?

I guess the question is "is important for who?" It's important for FACEBOOK to have that feature, it is important for DROPBOX to have that feature and then is it important for

ordinary people to be reminded of ordinary photos, different questions. But for people I think old photos can be really important as kind of reflective things, they do have the potential of you reflecting who you are, what has appended, what has changed. “Here is a picture of you 5 years ago” and then you starting to look at it “I remember that!” And that might be good. And of course, phototherapy is all about this, phototherapy really used the therapeutic part of photographs, meaning that they are tools for being very reflective about yourself. So, in that sense, yes, maybe people need it, but, why do these applications do it, maybe there’s a chicken-egg thing again. Do they do it because they think this will make their service more valuable to people, which is then… I’m not saying is good or bad, but if they produce something valuable that’s great. Or they might be tiring out. But I do think that in an emotional level people enjoy personal photos from the past. Or not even individually but as a group of friends together “Hey, let’s look at this, do you remember ten years ago when we made this trip together” and then, that’s good, I think that is good to reflect on social relations.

Whit the physical album, it’s easy to see it and remember to watch it. But with the photos on our phones we forget to do it.

But we don’t have these routines with this technology, because is new, we don’t have existing routines, so we might take old routines and try to fit them into the new technology. But if the technology is very new, we just don’t have it. And then we don’t look at old photos, and that’s probably what is happening.

Kodak Culture was mainly control by a single infrastructure, but in our survey we found that there are multiple interactions with every system in origin, purpose, cloud or social network use, storage and authorship. Do you think this will simplify to a more uniform infrastructure?

I think one of the things of doing that book and that research, and then stepping out from that research and doing this stuff that I’m doing now, is that became very critical about photo research, because photo research start whit the fact that photos are important.

I'm not saying they are not, but you should also be sceptical that do this people uses these apps for photography or do their use it for something else and then and then photos are an important part of that. And that's a bit different angle. And that came from the KODAK world, because KODAK was centred on photos and photography, but know if you look at this, if you look at WHATSAPP, SNAPCHAT or even FACEBOOK, is not centred on photography now, it's much more centred on communication, and yes photographs are very important in communication, but people don't necessarily think that I do this to do photography. I used SNAPCHAT to talk with my friends, I use WHATSAPP to keep in touch with my mother, and photos are important. So, this photo centricity is going away from people's minds, they don't see as a photo thing. And another example from a totally different angle is if you look at industry definitions, what is the photography industry nowadays. There's CANON and NIKON, they are camera manufactures, but then you have INSTAGRAM and SNAPCHAT that they handled hundreds of millions of photos a day, but nobody says that they are photography industry. So, these basic concepts are kind of braking and like when you asked the question "is there photo talk?", it's a very photo-centric starting point. Yes, there is talk, and some of the talk involves photography, but is not photo-centric.

Users use their camera for so many things, that only a small part of it is remembering.

For example, as you probably do this yourself as well. This is an example: I have a picture of socks, because a friend of my wanted me to buy them. This is a picture of something I need to put on the system. Or this one (of a map) because a didn't knew for sure if I was going to have connection on London and took the pictures (it's actually a screenshot) of the places I need to go, and that doesn't fit the family photo album at all.

In our survey, only 5% of the users had pictures on their phone that came exclusively from their camera. The rest had pictures from more than one source like, mail, social networks or apps like WHATSAPP. Should those images be treated in a different way? Because if you think in WHATSAPP, I can have a picture of my

nephew and a joke, and both images came at the same time, through the same channel and are both jpg. How do we separate them?

Well, I don't know. I think that for your research those are really interesting questions, because you are breaking some assumptions about photography. And these apps people are using, how many people is using WHATSAPP? and that app, the way it was design, forces that this to pictures are side by side, in a way equal in the system.

9.1.3. Joshua Fagans

Traditional albums have some extra info (year, some comments) that provide the context needed to understand any image, but in most of the cases that communication was oral. Mobile phones have access to a lot of our info, is that info enough to create that context?

Strictly speaking no, your mobile device does not have access to everything that was traditionally shared in an album. To be sure mobile devices have access to a lot of data, but the experience of an event is usually not well represented in social posts. Instead I would liken comments and likes to reviews of an event but the details of what happened and what things were like don't seem to be present online.

That means using social information, from our social networks could help create that context, but still, the user should always, at certain point, take part and manually complete the context info.

Exactly. Another aspect about the traditional album is that they were shared in person so even if information wasn't written down it was transferred on the spot. I'm not sure what the digital analog of this is but I haven't really seen it yet.

In our survey, 95% of the users had pictures on their phone that didn't came from their camera, they had pictures from more than one source like, mail, social networks or apps like WHATSAPP. Should those images be treated in a different way?

The images that we capture and receive on mobile devices are fragmented across a great number of apps and services with no way to coalesce them. This is a fundamental problem that needs to be addressed. I believe that they can and should be centralized in some interesting way.

Some of the current apps for managing photos aloud the user to choose witch image folders they want to manage (not in the case of IOS). This could take away some of the sources that we know for sure we don't want to save (screenshots, some apps) but some of the apps like WHATSAPP are huge source of images, but with very different values. Do you think we should "get rid of" some of the sources from the beginning or collect all the images and them organize them based on their value?

An example. Via WHATSAPP I receive photos form my nephew, that I value a lot, but also plenty of silly memes from friends, that I have no interest at all in keep.

I may be unusual but at least 1/3 of my phone camera photos are "notes." These are things like recipes as I head to go out shopping or books, I want to read etc. These are seriously polluting my photo pool. Similarly, photos from others like mail, chat, INSTAGRAM, etc. have varying degrees of importance. One probably needs some kind of setting that says photos from this person on this service are automatically added to my collection or not. On IOS there is currently no automated way to get photos from chats or mail into my photo collection which seems wrong.

In our survey we found that there is multiple interaction with every system in origin, purpose, cloud or social network use, storage and authorship. Do you think this will get simpler?

I don't see the number of services that we interact with getting appreciably smaller and because of this I'm not sure that things will get simpler in the near future.

By personalizing all the photos on a 1-person system, what happens when a person dies? How is the information transferred and how to merge it? It's possible to create a family space.

As far as I know there is not a great way to transfer digital content of any kind when somebody passes away. I think we are at the beginning of the age when this starts to get addressed since the first generation with an appreciable amount of digital content is getting to the age where they are thinking about this. I imagine a good number will find

ways to make allowances for passing digital content through some physical means as services work through the issues around it.

Some of the current systems offer one direction synchronization. Is the cloud the way to store our images or a way to sync them between devices or make a backup? Does the user need a copy? How does it work in the long term (many services have disappeared), we could always download the data, but about the context (metadata)?

The cloud is the correct place to store content though it is not currently practical for all photographers (those with terabytes of data). Users need access to all of their photos not necessarily all of their photos cached to all of their devices all the time. Currently, however, the major services are not really helping users organize their photo collections as they grow which will become a problem in the future. Cloud services that maintain copies of your photos will need to provide a way to download them if they are going out of business or if you are moving to a different service. Meta data like likes and comments could theoretically be attached the photos as they are downloaded but are definitely at risk of being lost.

If we want to storage the metadata of the image (likes, comment, etc.) we should use a standard, if we want to offer the user the security that he could leave if he wants. In professional world IPTC has proven to be a very useful tool, should consumer services use this same standard to "enrich" our photos?

Ideally yes though nobody is thinking about moving photos between services right now. Companies are more worried about expanding their feature sets and keeping you within their service. Ideally if I received a photo from you in a chat app it would contain the fact that it came from you, where it came from, and potentially any meta data you thought was ok to share: location, likes on FACEBOOK, etc.

If a system is design that could aloud the user to find exactly what is he searching for in all his photo archive, the "browsing" experience would have been lost. Is this search experience positive?

In my experience users don't actually know exactly what they are looking for. I do not have hard data on this but anecdotally I've heard of a user wanting to find a photo of their child in a specific sweater only to realize in the end that they were completely wrong about the colour the sweater was. Even if a system could perfectly tag a photo there is an issue where our memories are "faulty" meaning browsing in some fashion will always need to be part of the solution.

Do you think that systems should encourage the user to browsing without a clear target?

I think systems need ways to both browse and do targeted search. Part of the old album paradigm was seeing the unexpected.

Systems should work with previous photos, form digital cameras or paper scanned photos, and with current smartphone photos, reach in metadata.

Ideally all digital images should be in the same place.

But should the system try to "create" new metadata from old photos? The basic case is scanned pictures, that don't have date info.

I know some work has been done to try and find an automatic way to date photos though I confess I'm not sure where these stands. Ideally this would be true. It is interesting to note, however, that "modern" organization systems don't mesh well with undated or "fuzzy" dated photos where "fuzzy" dating is knowing a photo was taken in 1963 but not knowing specific time or date.

Photo albums where created as a long-term tool. Have we lost the long-term vision in photography?

I think "long term" artefacts will begin to be created for digital content as that content reaches a sufficient age. Digital content is still fairly new and as such has not needed to provide these, but I think we are beginning to see this change.

Lots of users said they don't have time to watch their pictures, and there's no physical album you can see and remember to check. Should the system invite the user to remember to see the photos? Should we have a trigger to activate that remember?

Absolutely. I think this is in part a failure of the software developers. The right tools have not been created.

What do you think of services like Rediscover this Day from GOOGLE PHOTOS, This Day by AMAZON PHOTOS or Flashback from the defunct Carrousel, could this be a good way to trigger our memory?

I think anything that causes you to revisit old photos is great. I wish there was more of it.

And should that be a moment to edit and create the album?

Not everybody made photo albums before, so I don't know that a digital analogue is the correct thing to strive for now.

We can know who is in the picture. Should we know who took the picture? The user can control who sees the pictures most of the time, and now even who is in the picture, but has no data about who made that picture.

I see no reason not to record or at least allow the system to record who took the picture.

As most of the photos users have on their phones come from family and friends), if the user could have info of the author of that image there would be a new filter category to help user rank their images. If we use the same example I have used before, If I could tell the system that the images taken by my sister are more

valuables, they picture of my nephew wouldn't have to be in the same place that my friend's memes.

Absolutely.

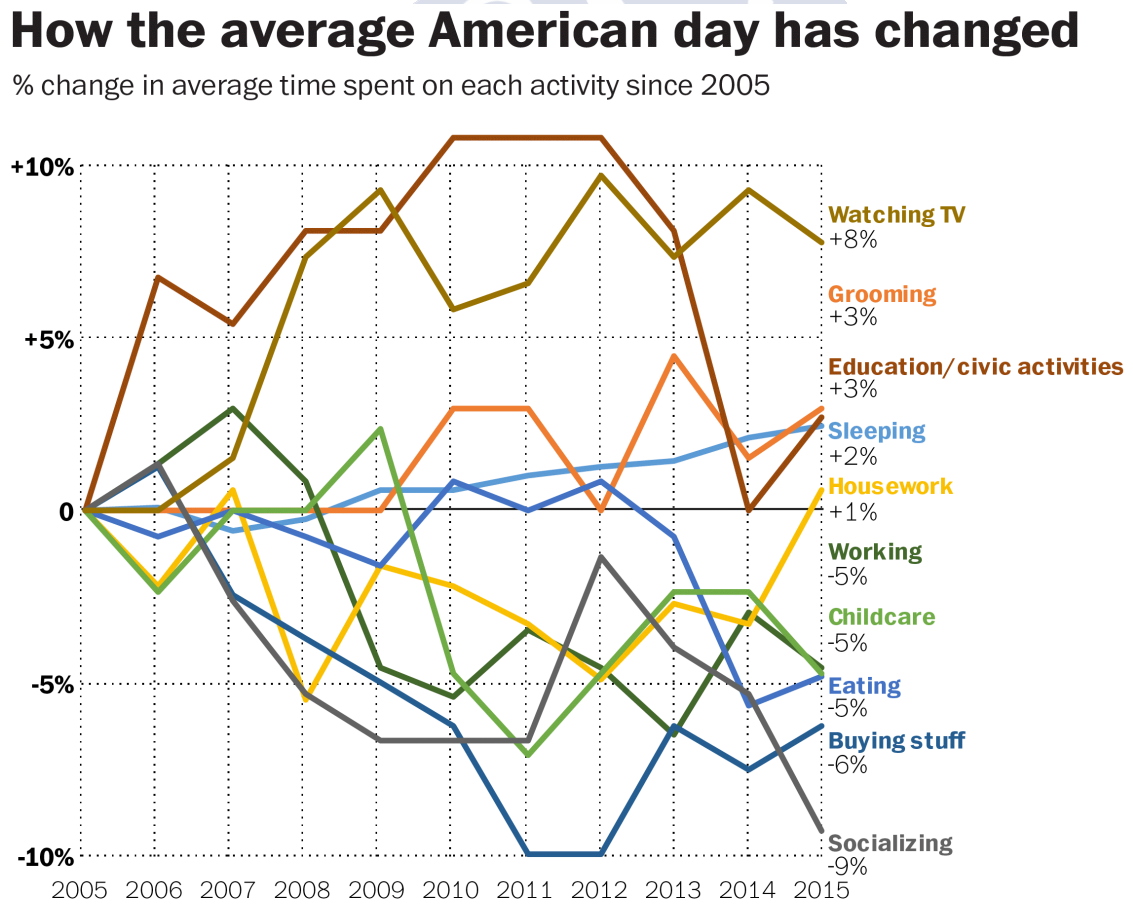
Photos used to be taken in special events where people carried a camera, now that we have the camera with us all the time, we take photos all the time. It's the "event" system to organize pictures dead?

No, the event system for organization is not dead. Events in our lives still exist and are still important. We have not, however, found good ways to characterize photos that are captured outside of events. Moreover, many photos on our mobile devices are more "notes" than photos and I am unaware of a system that truly takes this into account.

9.1.4. Richard Chalfen

In our survey, 75% of the users don't make any kind of physical album with the pictures taken with their smartphone. One of the most common comments is: "I don't have time for the album" Do we have less time o do we care less?

One problem here, common to surveys, is the variation in the ages of your 360 users. Yes, we know that young (younger every day!), middle aged and seniors all have smartphones, and all can take pictures. Each demographic group has preferences for time use making your question difficult. Regarding changes in time-use, at least in the U.S. since 2015… see the following.



Good time to question one of the primaries uses of physical albums in the past. Albums became an important component of many family gatherings, allowing family members and/or friends to see and discuss the same picture(s) – when they were physically together. But now, "being together" means different things; "presence" has been problematized and redefined and seems no longer a prerequisite of enjoying/using family pictures. People in different locations can now share electronic albums at a distance as you well know.

Each member of the family controls his camera and has his/her photo flow. Is there space for a family photo album? In that case, who should curate it? Who chooses what is public and what is private?

Very difficult question. First, we should ask: "what is public and what is private" to whom – under all interpersonal and/or social circumstances?

If circumstances call for or demand an album, in all likelihood curatorship will come from parents (assuming kids are part of a family and not just husband and wife or two partners I found kids are less interested in making their own albums, ones that represent their families – unless it is to humiliate of make fun of them. But kids are interested in looking at their parents' albums

Designation of what is public/private is a moving target. We have seen a lot of change in a relatively short period of time as to what is/isn't "acceptable" or "appropriate" in the family "presentation of self" (to reference Erving Goffman). My guess would be the more conservative partner, perhaps the wife more than the husband.

By the way, my last book, *PHOTOGAFFES -- Family Snapshots and Social Dilemmas* (Chalfen, Photogaffes, 2012) offers many specific examples of such problems.

If a system is designed that could allow the user to find exactly what is he searching for in all his photo archive, the "browsing" experience would have been lost. Is this browsing experience positive?

First, tagging provides a first take on the picture being searched for. So, this already exists, no? Assuming of course someone has taken the time to tag their photographs.

Second, reverting to questions about time, the personal context of a "browsing" task becomes very important. In some cases, browsing is a huge time-suck; you hear people complaining, "It takes too much damn time!" So, if a speedy search is required, browsing can produce anger and frustration. In comparison, if one has time, browsing can be very enjoyable, provide memory support and provide entertainment.

You mention in your book that we are documenting about 1% of our life. Now that we take more photos, are we documenting more moments of our life? Or we just have more photos of the same moments?

First, yes, we were documenting AND SAVING/storing about 1% for viewing in future times. But there is both continuity and change taking place. We are seeing a great overlap with pervious choices of participants, settings and topics. But we are also seeing photographers exploring the edges and fringes of such 'traditional' subject matter – thus, yes, we are documenting more moments of our lives but with less thought to save all of them for the future.

But again, it may be quite different for different generations. For young people it is a slightly different story. Here there is more playfulness, more exploration and experimentation.

With the current popularity of social networks, is photography more about identity and communication than memory?

Recommend: *Hand's Ubiquitous Photography* (Hand, 2012) by Martin Hand; and many papers by José van Dijck. Starting with *Mediated Memories in the Digital Age* (Dijck, 2007). and many papers by Nancy Van House, namely: *Personal photography, digital technologies and the uses of the visual* (House, 2011)

There is a need to clarify meaning of "communication" e.g. instant communication vs. long term, even cross-generational communication among several other variables.

Albums where created as a long-term tool. Have we lost the long-term vision in photography?

Yes. Again, am I assuming you are talking about forms of amateur and/or family photography? All sorts of points and angles on this question.

One key question that ordinary people need to be asked involves if and how their grandchildren might ever see the pictures that are being made today. I don't think people have lost a need or wish to have a vision of their futures or, as I am assuming you are asking, what they will have to see and look at in futures years. In the back of their minds, people are rather uncertain as to what kinds of pictures or technology will be available to them 20, 30, 40 years from now. Everyone (or many people) has heard stories of some of KODAK 's colour/Kodacolor prints fading over time… But at least there was something to hold onto. But now there are questions of access. One example of so many 16mm. 8mm and Super-8 films/movies that can be transferred to videotape and then to digital formats… CDs, thumb drives onward to cloud existence... Of course, these can be done but some transfers are proving to be very expensive. So, what will people have and how will it all be looked at if at all?

Aside from digital "albums" created by family photographers as part of their storage software e.g. iPhoto, we should acknowledge a stage that is not mentioned very often, namely the production online family sites and family web pages. These were early digital albums that, interestingly, (1) promoted more verbal/written "captioning" and narrative previously missing from physical album formats, and (2) encouraged more contributions (pictorial and verbal) from family members.

In addition, we must add the trend toward people making physical albums using online album-making services such as Shutterfly.com and Snapfish.com, just to mention two that I use. Several families I spoken with have shown me a small collection of such books/albums that document bits and pieces of their lives, ones that were always highlighted in physical family albums. Lots to say about differences…

Granted that digitally organized and edited albums are considerably different; but there remains a sense of need to bring some organization to (1) the flood of pictures now in family members' rapidly expanding photo archives and (2) to abilities to retrieve photographs when needed or wanted. We all need to sit and talk to older family members who used to collect their paper-backed photographs in shoe boxes and bureau drawers – people who met with similar needs and frustrations.

The most obvious and key point is that, as you well know, image production/viewing is changing at an extraordinary and rapid pace, even within the same generation of family members.

By personalizing all the photos on a 1-person system, what happens when a person dies? How is the information transferred and how to merge it? It's possible to create a family space.

While I know this can be a real problem, I have not studied it. Though I know some lawyers are asking about this and related questions of "picture property" when they are writing wills for their clients.

Just as a coincidence, I received the following article that may be useful to you: "What happens to your online accounts when you die" (Moreau, 2016).

The notion of "family space" is applicable the development of online family pages mentioned above.

Traditional albums have some extra info (year, some comments) that provide the context needed to understand any image, but in most of the cases that communication was oral. Mobile phones have access to a lot of our info, shouldn't they use that info to create that context? And should they also use information from our social networks?

"Yes" of course is my answer to the first question; such information will enhance the value of the collection and "Not Sure" is my answer to the second part. More comment to the first part is included in a later response.

Kodak Culture was mainly control by a single infrastructure, but in our survey, we found that there are multiple interactions with every system in origin, purpose, cloud or social network use, storage and authorship. Do you think this will simplify to a more uniform infrastructure? (Graphic 2)

I'm pleased to mention that several scholars have asked similar questions about the applicability of my framework, one that was originally designed in the 1980s (!). Specifically I have in mind Dr. Asko Lehmuskallio who, with Edgar Gomez Cruz, has recently published a collection of essays which I feel you will find extremely useful, namely *Digital Photography and Everyday Life: Empirical studies on material visual practices* (Gomez & Lehmuskall, 2016).

Years before, Asko, while working on studies digital of photographs, saw the need to convert my original framework to changing circumstances (as you suggest) and developed the following chart as a very good way of illustrating changing trends of personal visual culture:

Chart is missing

In our survey, only 5% of the users had pictures on their phone that came exclusively from their camera. The rest had pictures from more than one source like, mail, social networks, screenshots or apps like WHATSAPP. Should those images be treated in a different way?

It seems to me that people are generally enthusiastic about collecting pictures and getting them anywhere they can! Seems they want to save them for at least a short time! Stealing them is included here. Second, it's clear that we're not just talking about family photography. This seems a very good example of possibly asking the original concept of "Kodak Culture" to do too many things.

WHATSAPP like apps are the second source of photos on smartphones in number of users, with 90% of the users. Are WHATSAPP family groups the closer to a "family" photo album

I have not thought about this very much in part because I am mostly unfamiliar with the contents and general thinking about WHATSAPP.

One general question we may want to ask: Is the content of pictures from all these sources (in Graphic 1 for instance) relevant to all members of a "family" and second, what or who is being considered as a member of a family?

More to the point may be a needed careful consideration of "personal" vs. "impersonal." The pictorially-centric social media you mention have more to do with impersonal meanings (meaning: might be a nice photo but NOT relevant to me personally, as in: family members) and personal ones.

In recent history, when family members or kids used to ask to see the family album, a mental framework was used to set and operate a set of personal expectations which, in turn, guided the viewing experience. This framework was personal-oriented meaning viewers would know the people appearing in the photographs and often know who took them AND could anticipate who would be looking at them. There is a forgotten reference that I found very helpful, namely: *Cameras don't take pictures* (Byers, 1966). My point here is that acknowledgement of being able to identity players in the photographer-subject matter-viewer triangle of relationships is very important to "personal-impersonal" dimensions and to the kind of communication that is in play.

As an aside, I can also claim that in current times, such points of identification of such "players" as well as date- and place-information seem less and less important… This is admittedly a huge discussion that needs lot of clarification not possible here. But it does get back to what is now included in photo albums which may be getting less personal. Of course, I have been referring to a time when a family may have had only one camera and its use may have been limited to "DAD" – hardly the case in 2016!!!

The context is crucial in a photo album. Where should this information come from in the case of mobile photography, just the phone or social networks and apps? Might that cause privacy issues? Should the user always add some personal info?

Agreed! But what "users" should do and what actually happens may not overlap.

Context is crucial, but in the case of older and some current family photo-albums, providing space-time information ("data") was less favoured than taking pictures. Attempts at labelling are found with users either writing on the back or even on the front of a photograph. As I mentioned previously, organizing the album and especially writing captions (even just the dates) was the "work" or non-leisure component of the process and was often avoided and missing. And this was a time when family members felt their photographic records would be interesting to their kids and grandkids and future generations of family members – all a part of long term communication.

People have been satisfied to state: Pictures speak for themselves… NO THEY DON'T! And there is overlooked question: To whom?

Now, tagging is problem for the digital counterparts. Second my feeling is that family digital pictures are valued in very different ways – most importantly, not as long-term keepsakes – but short-range communication. Their value has changed dramatically in part because people feel taking pictures is very easy and less expensive.

I would like to see the following: Photographers (or image-collectors) should be able to use the microphone function of their phones to add or supply some personal details to each image, replacing spoken context for a written one. I know this must be technologically possible! I also think this suggestion most directly addresses your central thesis point regarding connections to what family albums did. This suggestion will possibly restore some sense of long term value – but, of course, does not mean people will actually do it. In short, you can lead a horse to water, but you can't make the horse drink it.

Feelings about "privacy"? Who knows!

Some of the current systems offer one direction synchronization. Is the cloud the way to store our images or a way to sync our images between devices? Does the user need a copy? How does it work in the long term (many cloud services have disappeared)?

Not certain how to respond. But I strongly feel the user needs a copy!! No further thoughts – sorry.

Pictures on fridges and walls had the role of "remembering to remember". Do we need some kind of "digital rogue galleries" or some trigger to remember/remind us to check our pictures?

"Remembering to remember" is a great phrase! Especially for a digital age when people can get their IPHONEs to remind them of everything from someone's birthday to going to the bathroom!

It's important to realize that pictures on fridges and walls had and continue to have many functions. Somewhere between the personal and public display of personal information that often included drawing attention to "how good people had it" e.g. as ways of bragging and showing off. Also important to check where in a household such pictures may be displayed. Master bedrooms represent quite different spaces than kitchens, living rooms, front hallways, etc. and, in turn, promote different meanings to pictures that appear there.

Photos used to be taken in special events where people carried a camera, now that we have the camera with us all the time, we take photos all the time. It's the "event" system to organize pictures dead?

First, perhaps we need a better definition or understanding of what constitutes an "event." There is lots of space between special public events (holidays) to private events (weddings, birthdays) of life cycle. Second, some events – but not all -- seem to have a "demand characteristic" of being photographed. That is, there is a tradition of actually possessing such pictures or that an event should be photographed; something (an event)

is not done "right" unless it has been photographed. So there are degrees of "picture-worthiness." Third, and again, age of camera-user makes a big difference. Young people seem much more likely to find or create "moments" for photography; perhaps less so with adults. Forth, we have to be careful of the phrase: "take pictures all the time." I know we can all think of times/events that demand we put the camera way (See book Photogaffes for examples) -- so again it is selective process that designates the photo-worthy event. Lastly, the fact that most of us can take pictures so easily teases some people to want to improve their photography by doing more. A most positive aspect is the potential for getting people to "notice"– to look more carefully at their surroundings/environment; here, again, I am thinking of year-long "one picture-a-day" projects.

In our survey, the last question was "You have probably seen pictures of you parents and grandparents in photo albums, do you think this will happen in the future with the pictures you have now in your phone?" For my surprise, more than half of the users answer: "No, most of the pictures of my phone will probably be lost". So that means that there is a general sense of frustration regarding photo management on mobile devices.

Yes, there ought to be a tab titled: Send to folder of photos… cloud location?... for pictures that must be kept for all time!

It still interests me (and mildly annoys me) that so many people are so wrapped up in the present, (even making/revising FACEBOOK profile photos), forsaking the knowledge they have of what gives them pleasure namely having glimpses of their own pasts, meaning what their parents and grandparents did and how they lived their lives. Is this too much "work"? Is the latent manta: "Think for now and not for later"? In the history of the human condition (rather a grandIOSe claim I realize), humans have never had the opportunity more than we do today—to hold onto view/representations of their pasts—and yet….

All of this in face of growing indicators that people what to know about their ancestry, their pasts, where they came from, their heritage, their roots, etc. Including – "what they looked like." (see my "Looking Two Ways: Mapping the Social Scientific

Study of Visual Culture." The SAGE Handbook of Visual Research Methods edited by Eric Margolis and Luc Pauwels, pp. 24-47, 2011). These seem to be conflicting drives and interests…

9.1.5. Jessica Bushey

In our survey, 75% of the user don make any kind of physical album with their smartphone cameras. One of the most common comments is: "I don't have time for the album" Do we have less time o do we care less?

The tools we use shape our habits. Cameras are now digital and sharing is primarily done online through social media platforms.

Each member of the family controls his camera and has her/her photo flow. Is there space for a family photo album? In that case, who should curate it? Who chooses what is public and what private?

Family photo albums in the digital environment take different forms – FACEBOOK pages, Shutterfly books, INSTAGRAM pages etc. I believe there is space for the family photo album, but it is virtual and therefore requires ongoing management to ensure that it remains accessible for future generations.

Curation involve selection and organization, I believe it is a combination of the creator and the platforms. Many people edit while/when shooting, so the images that are shared have already been curated. Again, what is private or public is determined by both the creator and the chosen platform.

WHATSAPP like apps are the second source of photos on smartphones, with 90% of the users. Are WHATSAPP family groups the closer to a "family" photo album

I'm not sure. I find the archiving capabilities of WHATSAPP limited, unless everything is being backed up on the Cloud. To me the "family photo album" should be accessible to future generations of the family, and I'm not sure how that would be achieved with WHATSAPP.

Richard Chalfen said that we are documenting just 1% of our life. Now that we take more photos, are we documenting more moments of our life? Or we just have more photos of the same moments?

I think the answer is both – we are documenting more aspects of our life (e.g., weddings, graduation AND food, selfies etc.) and we have more images (e.g., easier to take 100 images of a wedding because digital is cheap and easy) and we have more images of the same moment (e.g., at a graduation everyone in the family will document the moment from different angles, different devices etc.).

Whit social network is now more about identity and communication that memory.

Each social platform has its own characteristics and capabilities that shape how it is used and whether individuals use it for shaping their identity or as a tool of memory. This also changes as new platforms emerge. For example, at first FACEBOOK was about identity (Harvard students) then it became about sharing and then it became about memory (because now it is mainly for families to stay in touch). Currently, college students don't care much about FACEBOOK.

Albums where created as a long-term tool. Have we lost the long-term vision in photography?

Absolutely. I believe younger generations view photography as a short-term communication, it documents "the now". The idea of photography as a keep-sake, something that is precious and will be stored and last forever is no longer applicable to the digital environment.

By personalising all the photos on a 1-person system, what happens when a person dies? How is the information transferred and how to merge it? It's possible to create a family space.

If the digital images are shared on public platforms then everyone has access to them. If the digital images are held within social media accounts that are protected by

passwords, then legally, nobody has access to the images after the creator dies. Digital assets held in the cloud are considered property of the social media company.

Traditional albums have some extra info (year, some comments) that provide the context needed to understand any image, but in most of the cases that communication was oral. Mobile phones have access to a lot of our info, shouldn't they use that info to create that context? And should they also use information from our social networks?

Image metadata (information about information) contains technical and contextual information about the how, when and where. Creators must use external programs to provide why and who. Comments and tags provide this type of information.

Kodak Culture was mainly control by a single infrastructure, but in our survey, we found that there are multiple interactions with every system in origin, purpose, cloud or social network use, storage and authorship. Do you think this will simplify to a more uniform infrastructure? (graphic)

Well... FACEBOOK owns INSTAGRAM, and these are two popular social media platforms. The monopoly over social media platforms and massive repositories of image and textual information is going to be a serious concern in the years to come.

In our survey, only 5% of the users had pictures on their phone that came exclusively from their camera. The rest had pictures from more than one source like, mail, social networks or apps like WHATSAPP. Should those images be treated in a different way?

Archives have always been made up of materials that are created or received by an individual or an organization. I don't see any reason why these images should be treated differently. However, the access/privacy restrictions and/or copyright issues might be different for images you receive vs. images you create.

The context is crucial in a photo album. Where should this information come from in the case of mobile photography, just the phone or social networks and apps? Might that cause privacy issues?

Every bit of metadata you can grab and save is important from all the devices, software and platforms. It is less a privacy issue as it is a proprietary issue. Social media companies do not readily share their metadata with outsiders, unless you pay for it.

Some of the current systems offer one direction synchronisation. Is the cloud the way to store our images or a way to sync our images? Does the user need a copy? How does it work in the long term (many services have disappeared)?

This is an interesting question. I believe that use of the cloud is still early and so we don't know all the ways it will be used or impact our approaches to storing, accessing and sharing our images. I prefer to think of it as backup and synchronization. But I believe for most people it is primarily storage.

Picture on fridges and walls had the role of "remembering to remember". Do we need some kind of "digital rogue galleries" or some trigger to remind us to check our pictures?

You should look at the work of William Odom (Microsoft Researcher and Post-doctoral Fellow at SFU) he does very interesting work on interacting with our digital images collections in the house.

Photo talk discussion around screen-based photo curation. 10 years ago, wasn't really working, how do you see it now?

I would need more information to answer this question. Sorry.

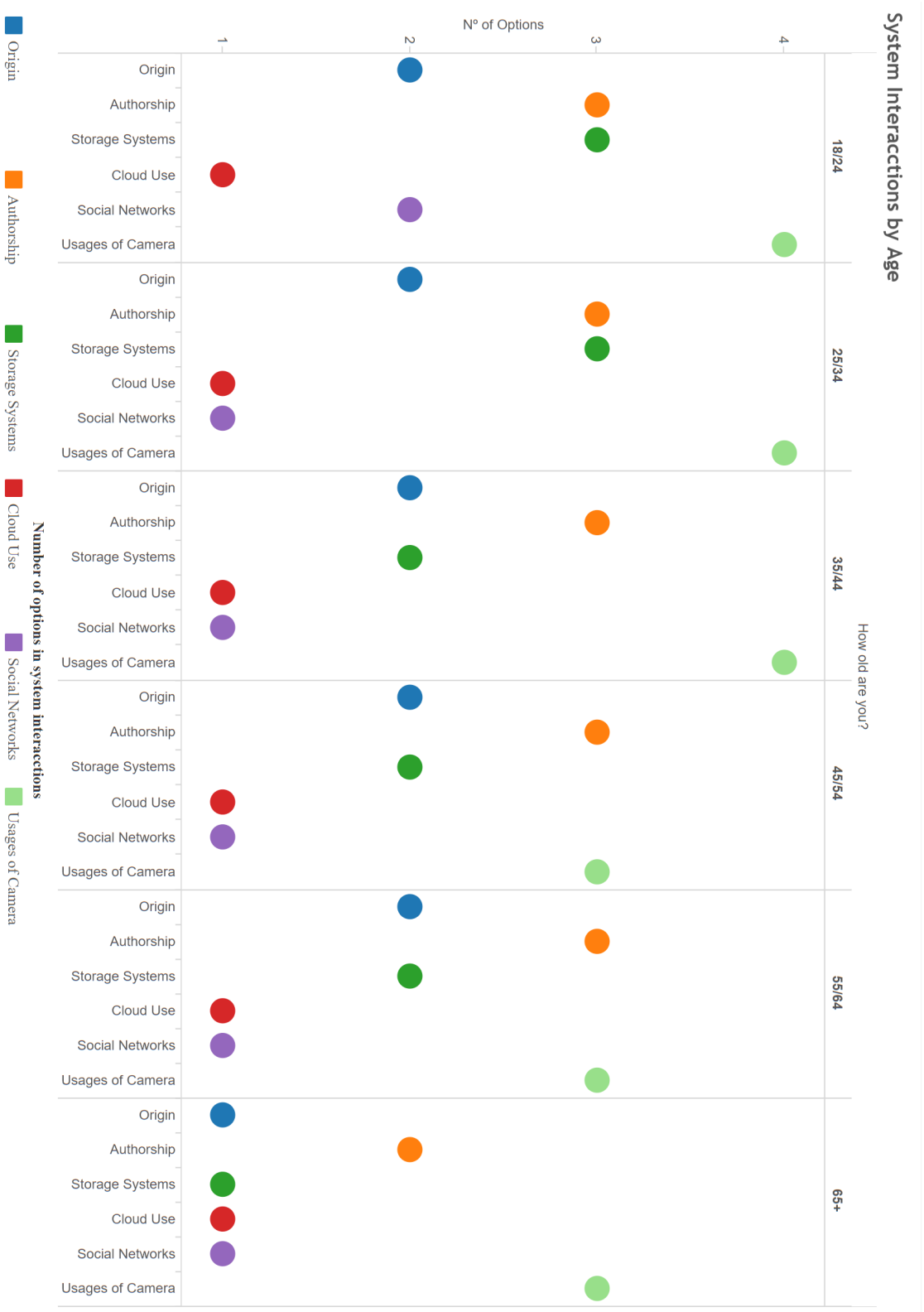
The TV is the biggest screen in most of the cases. What role do you think it has on the photo-talk and discussion and how important do you think is the connection between devices and secondary screens.

I think the role between devices and screens is important, I'm not sure the TV has much to do with images anymore. Most people show their images on their phones and phones are now getting bigger so that the screens can be viewed more easily for watching videos and television programs.

KODAK made the path of what we should photograph and how. Who is drawing now those guidelines? Why are we doing selfies? Mobile manufactures, Social Networks or it's outside the industry?

Interesting question, but I'm not an expert on the topic or history of selfies. I believe that photography is a sociotechnical practice, which means that it has evolved throughout time in response to social and technical/technological influences.

9.2. TABLES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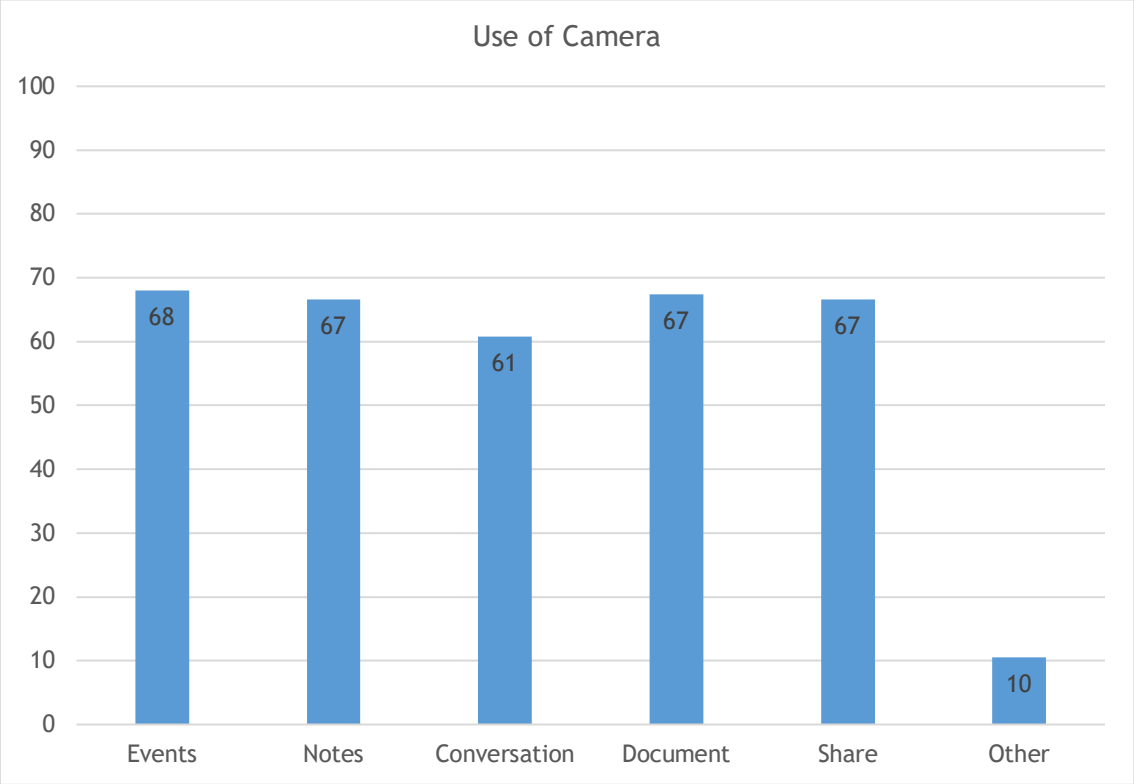
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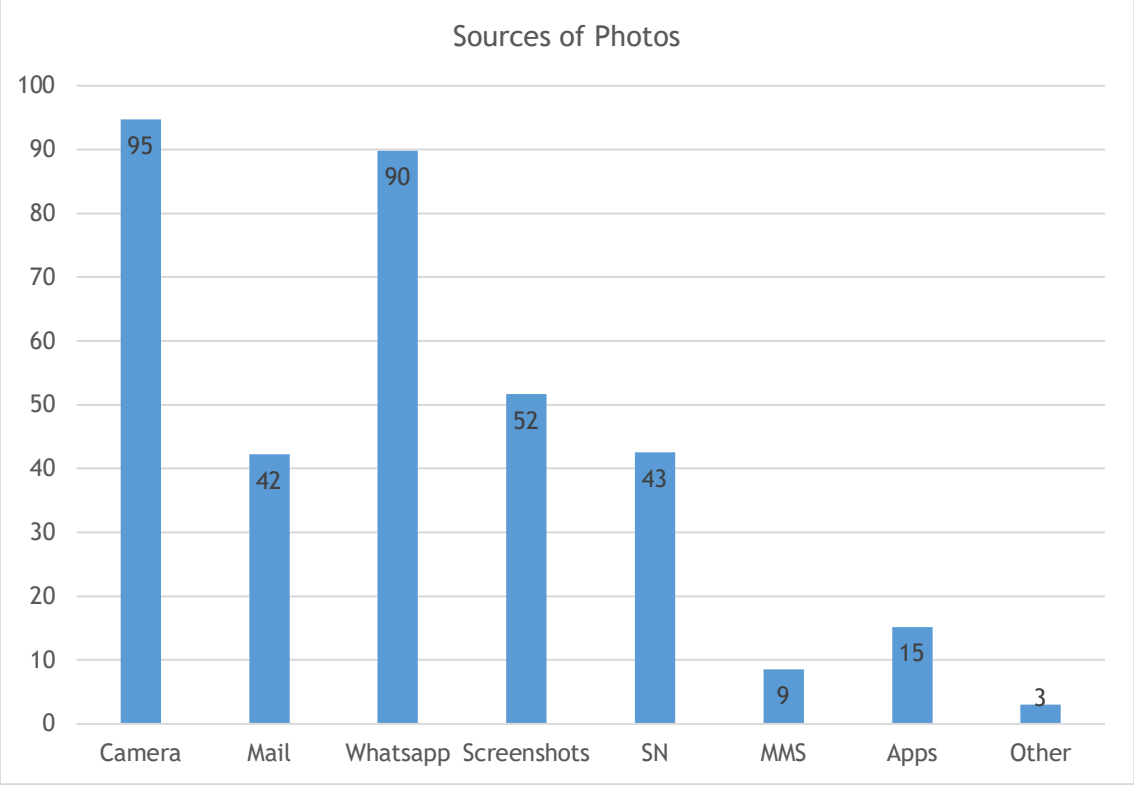
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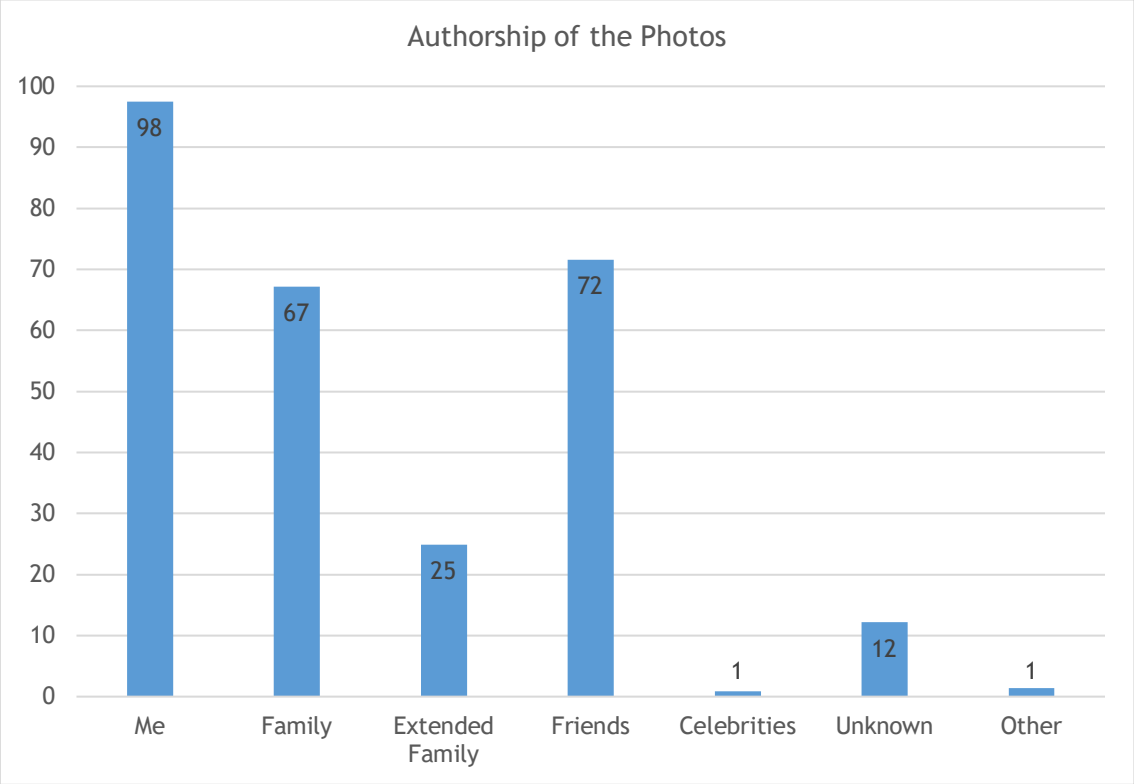
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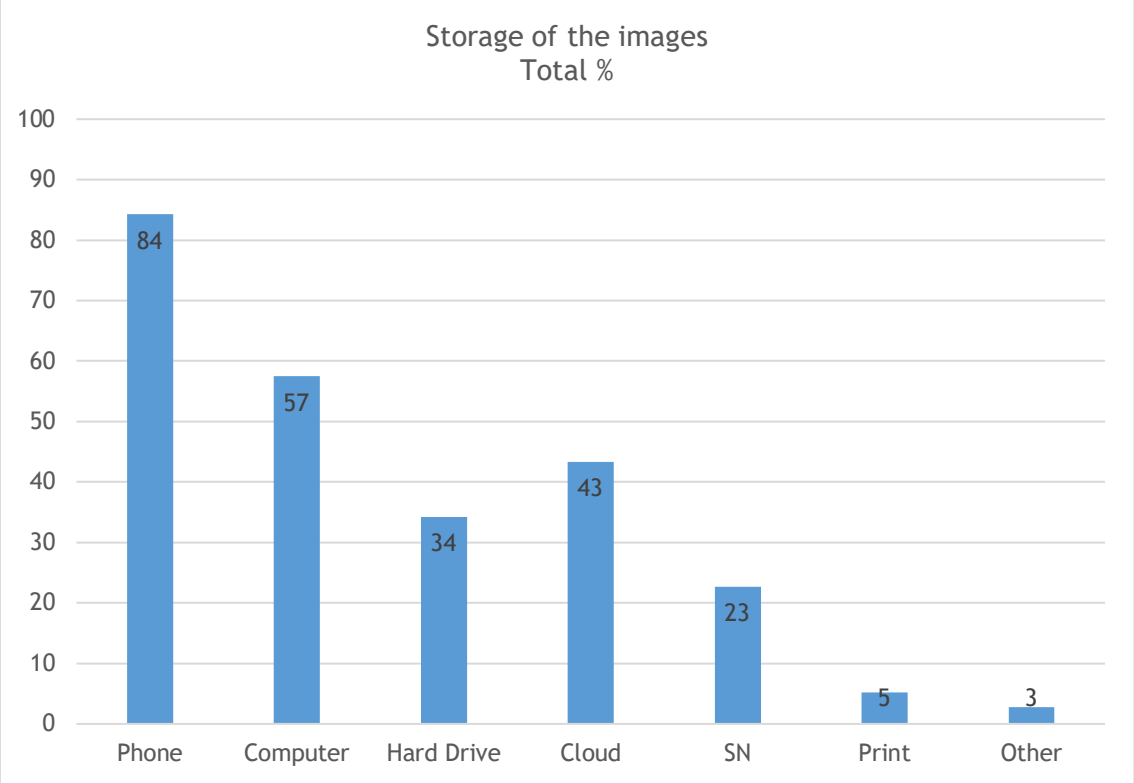
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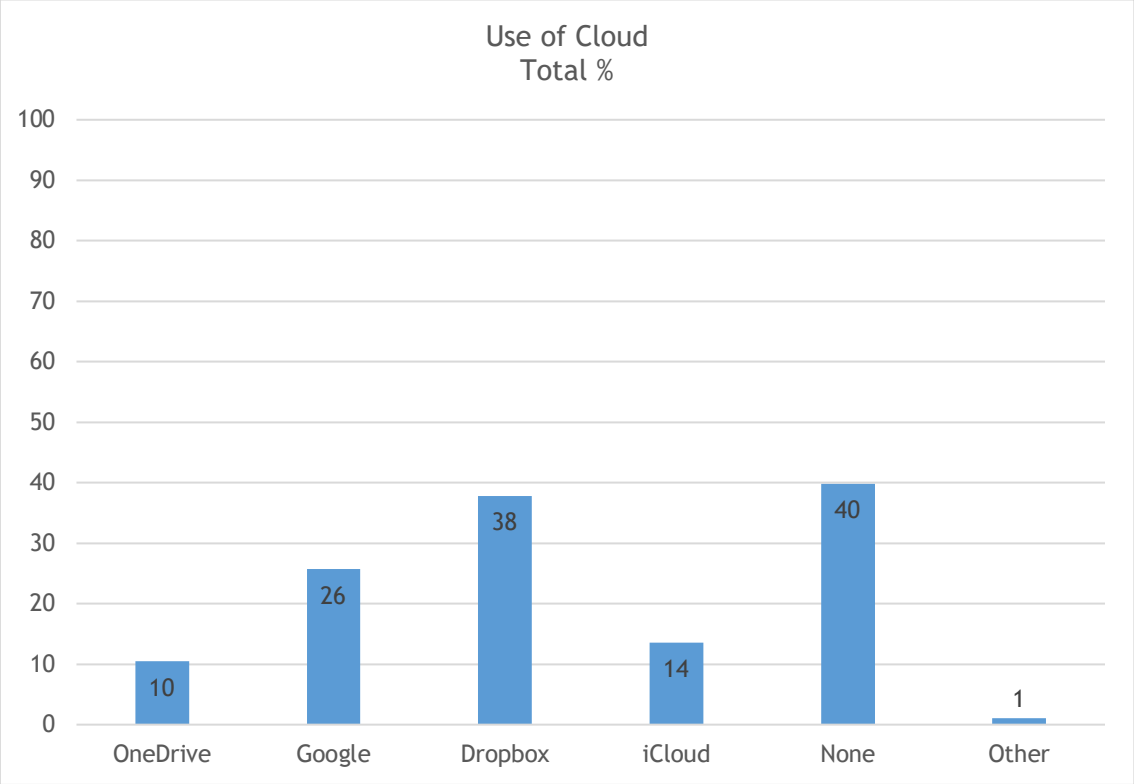
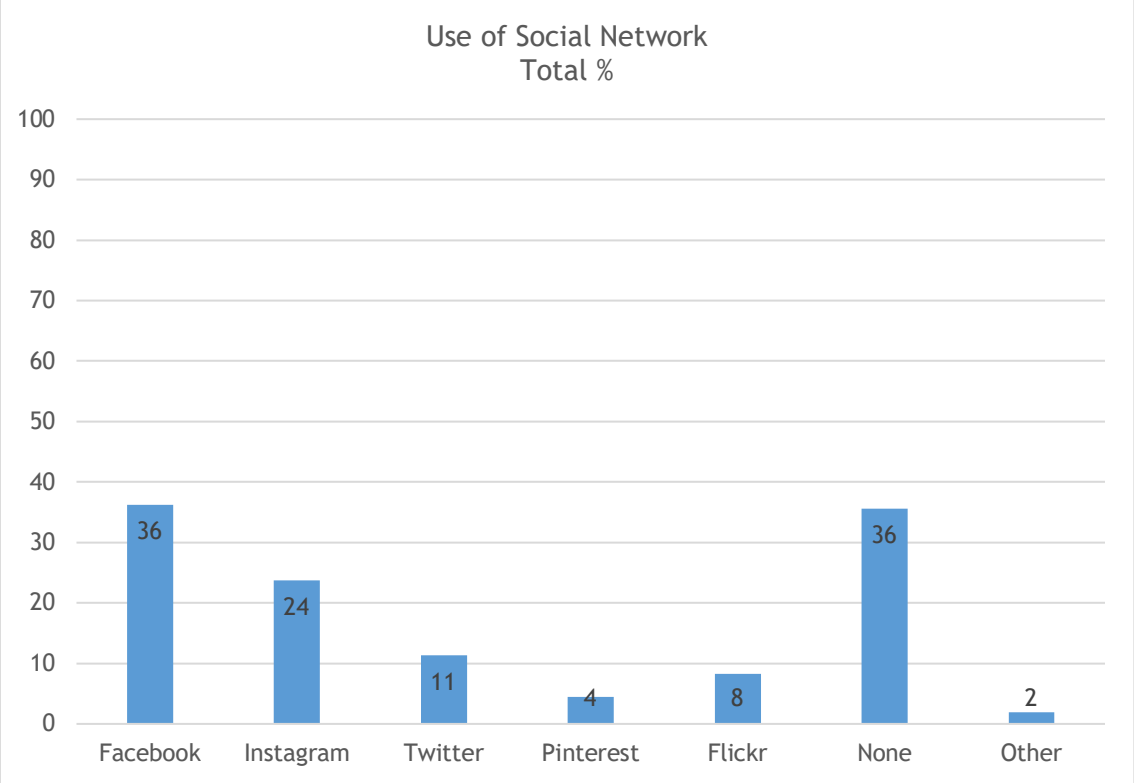
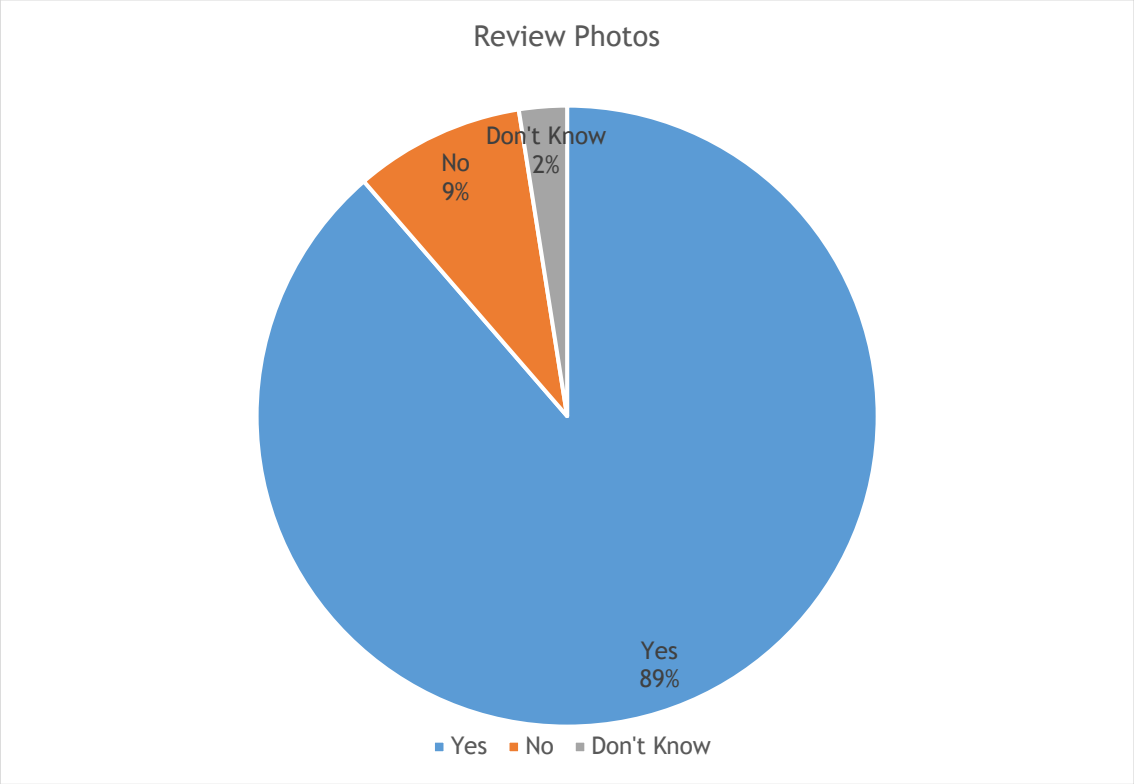
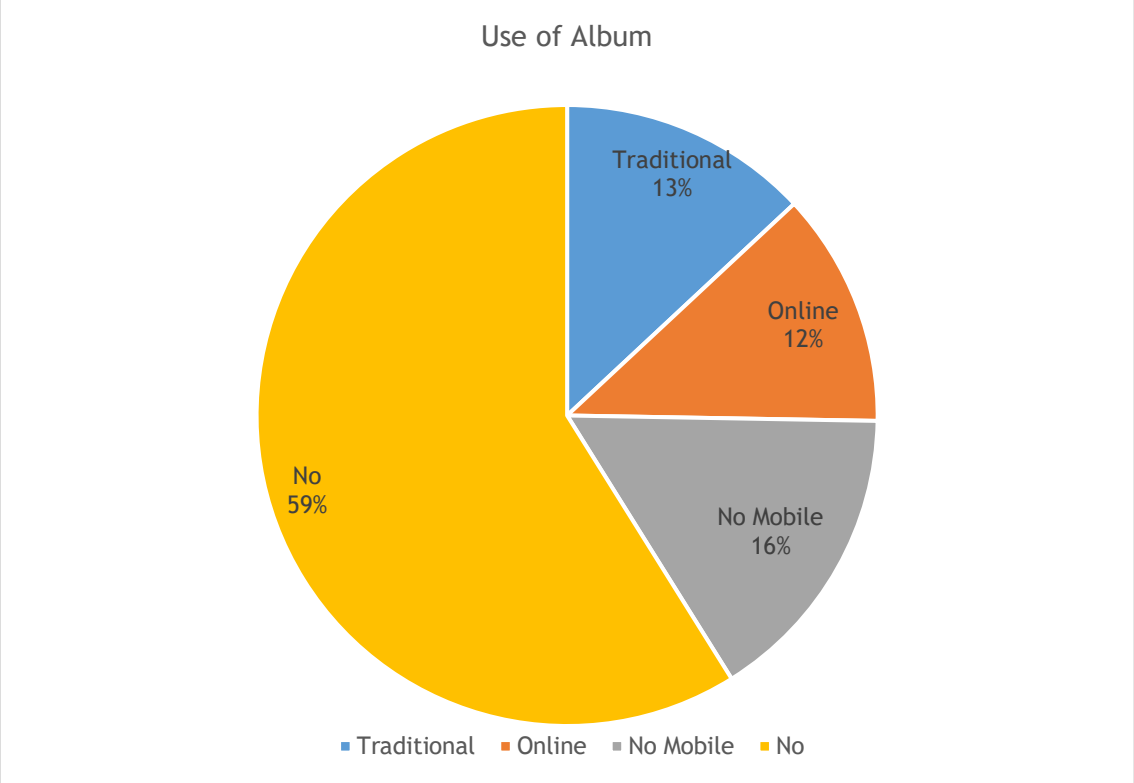
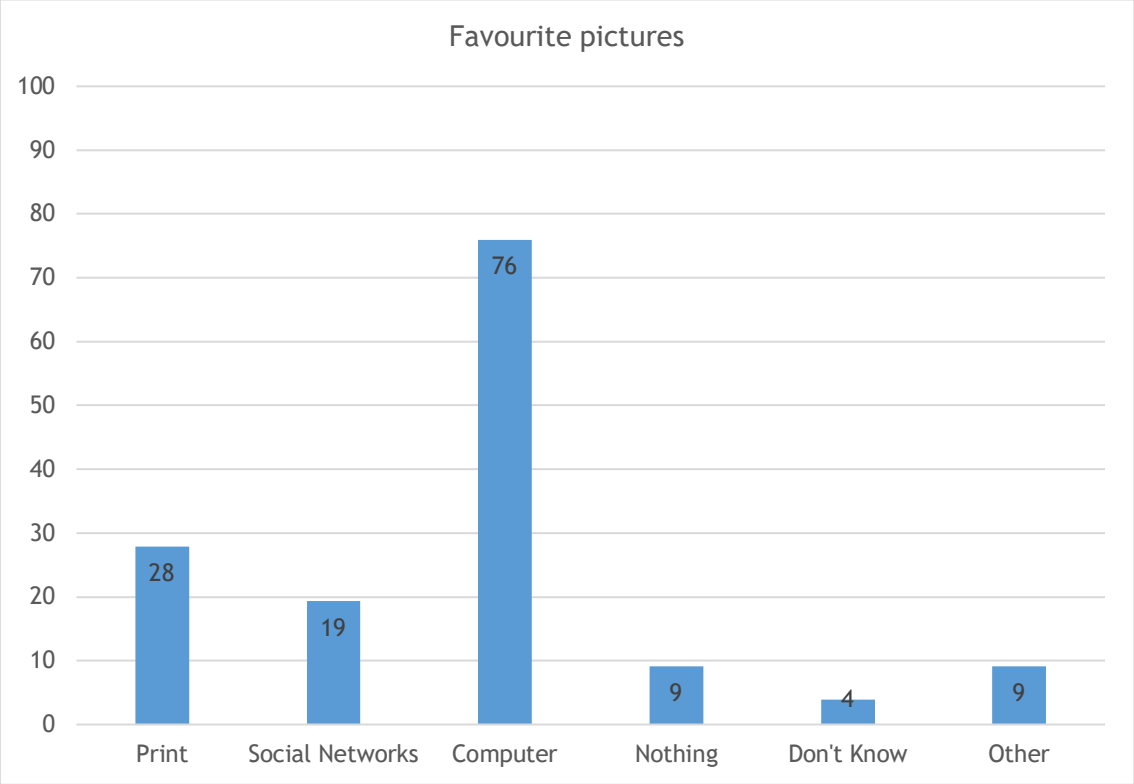
Computer
Hard Drive
Cloud
SN
Print
Other

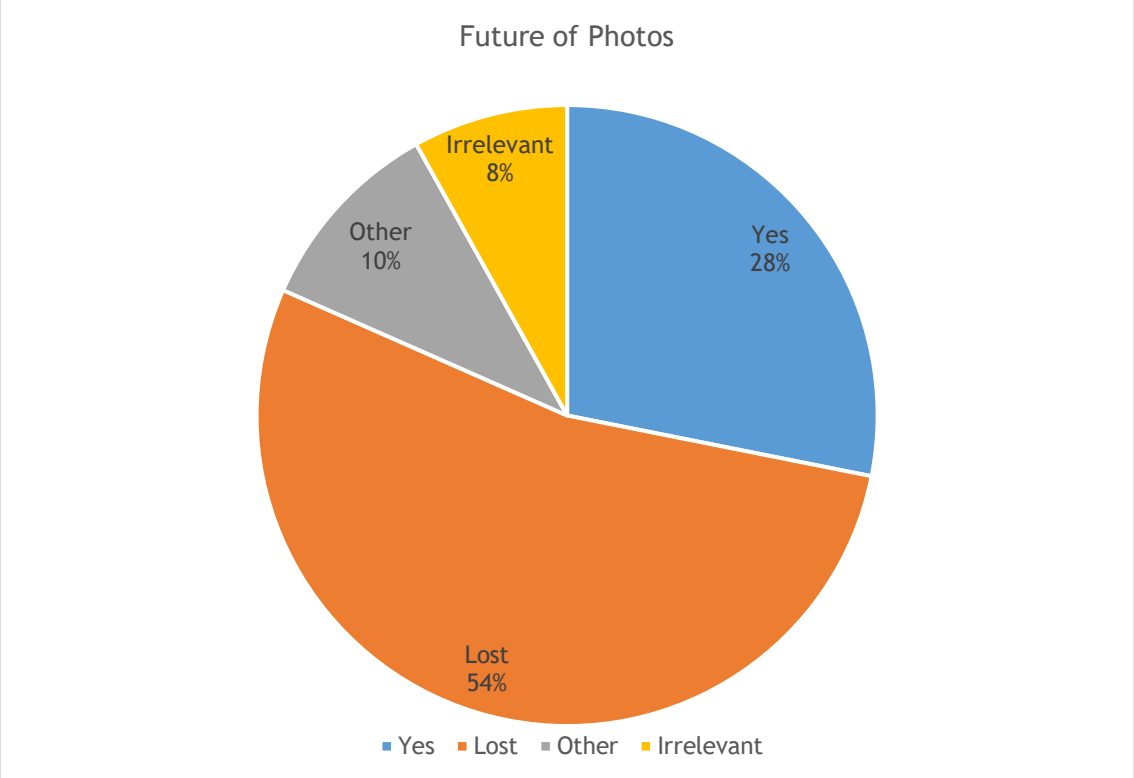

Use of Cloud
Total %
100
90
80
70
60
50
40
30
20
10
0
10
26
38
14
40
1
OneDrive
Google
Dropbox
iCloud
None
Other

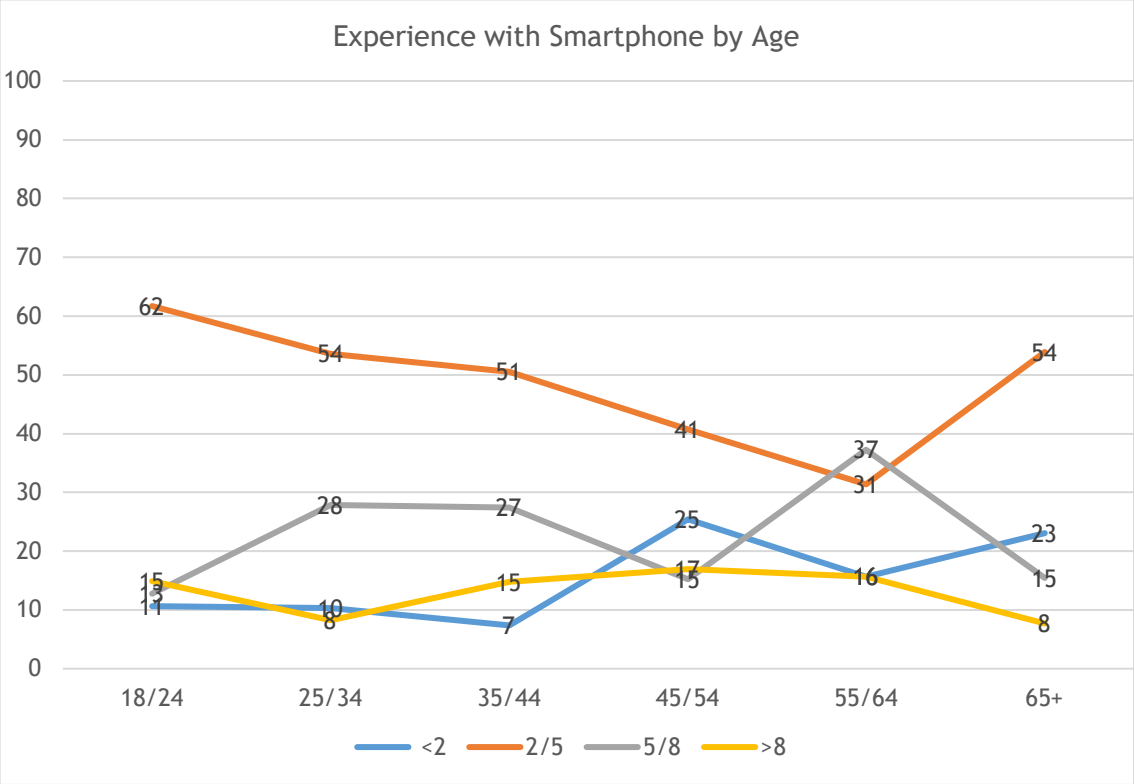

Use of Social Network
Total %
100
90
80
70
60
50
40
30
20
10
0
36
24
11
4
8
36
2
Facebook
Instagram
Twitter
Pinterest
Flickr
None
Other

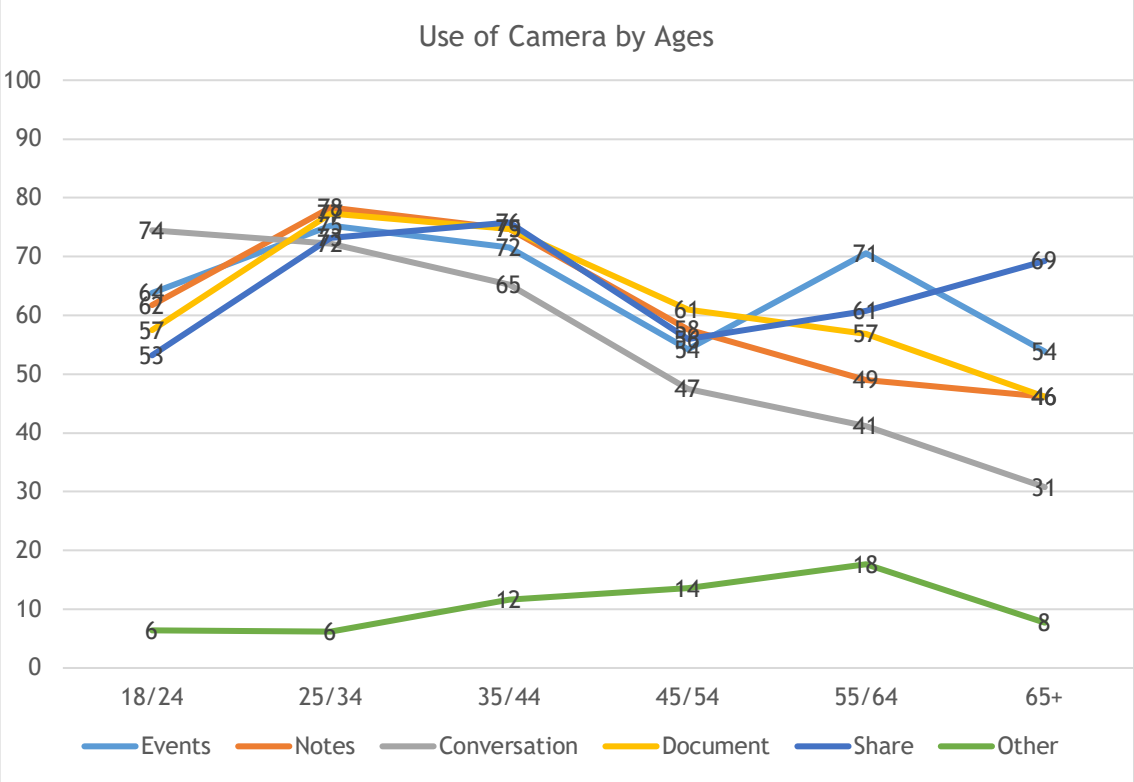

Review Photos
Don't Know
2%
No
9%
Yes
89%
Yes
No
Don't Know

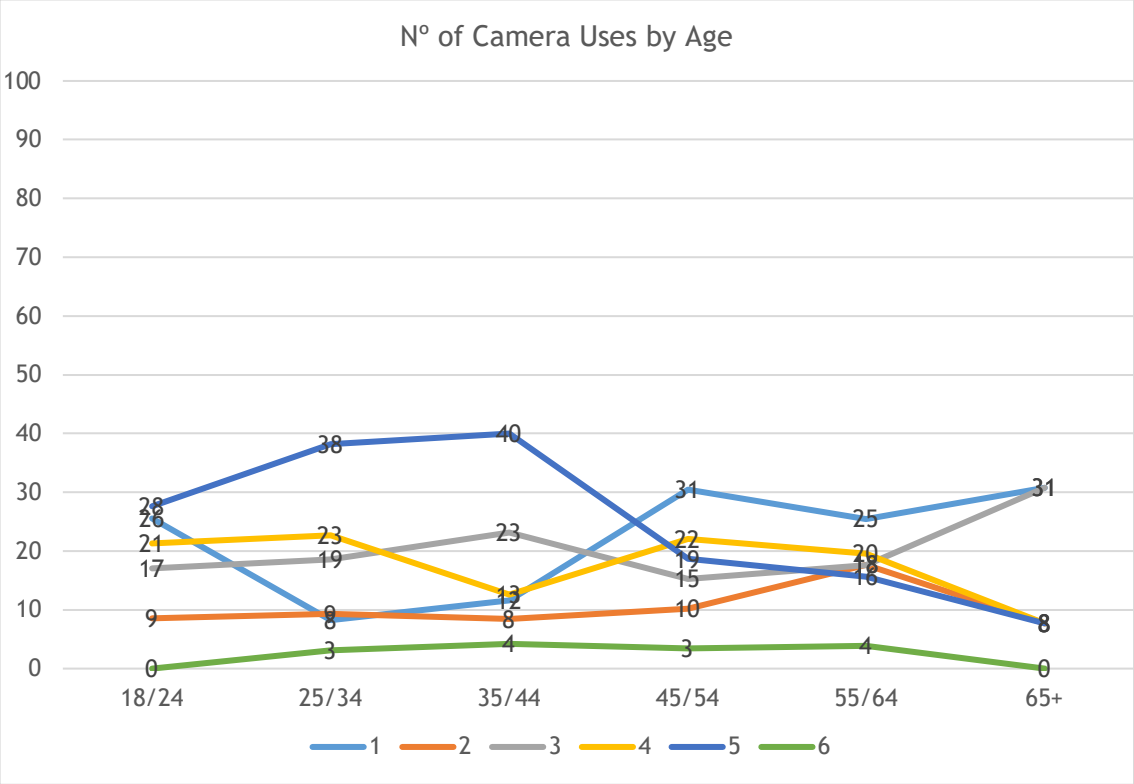

Use of Album
Traditional
13%
Online
12%
No Mobile
16%
No
59%
Traditional
Online
No Mobile
No

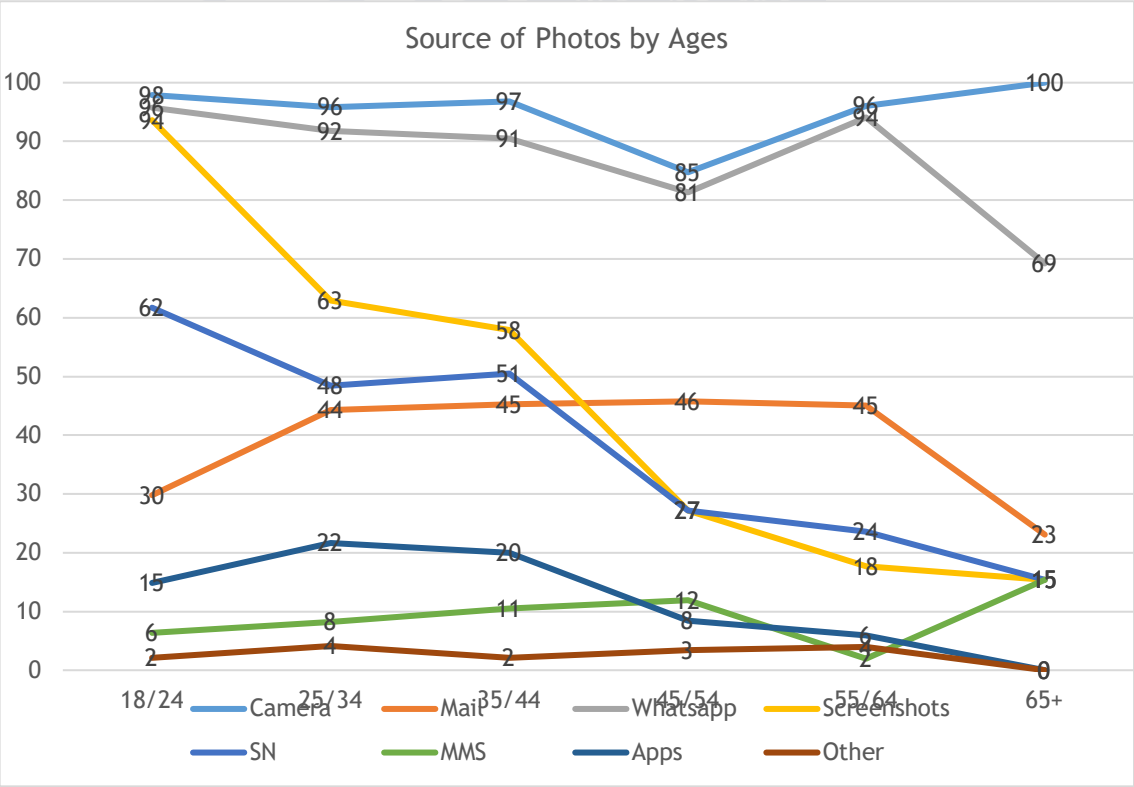

Favourite pictures
100
90
80
70
60
50
40
30
20
10
0
28
19
76
9
4
9
Print
Social Networks
Computer
Nothing
Don't Know
Other

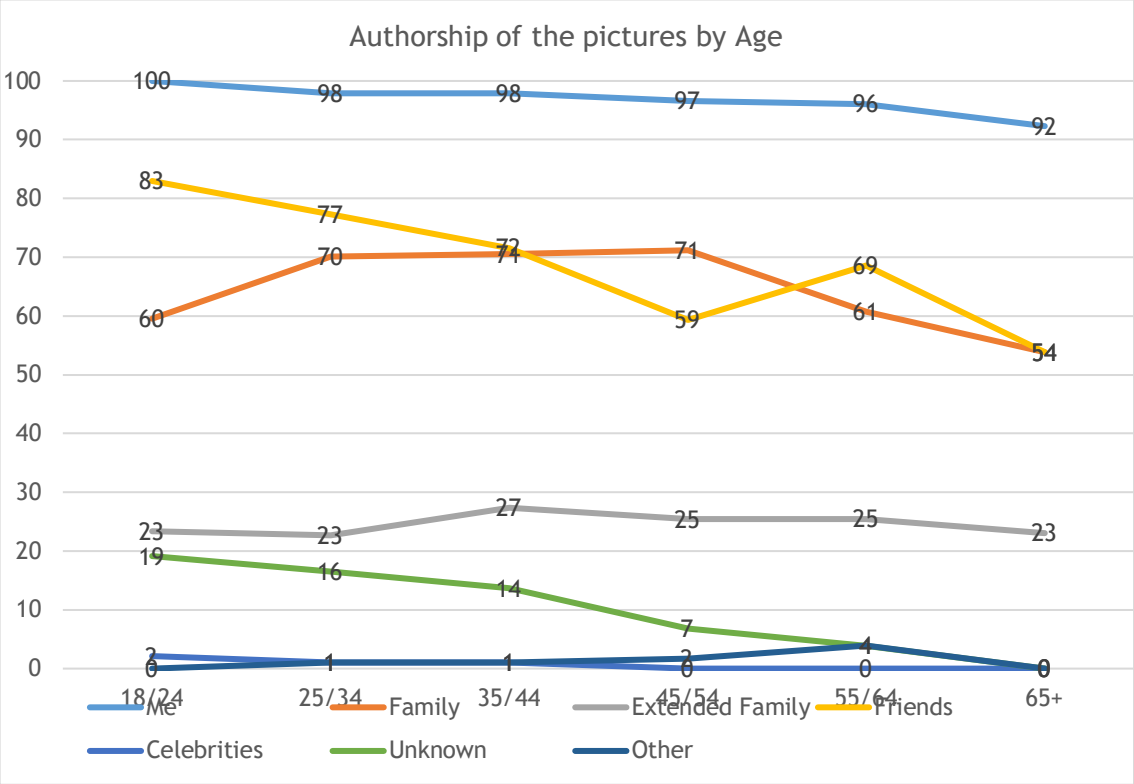

Future of Photos
Irrelevant
8%
Other
10%
Yes
28%
Lost
54%
Yes
Lost
Other
Irrelevant

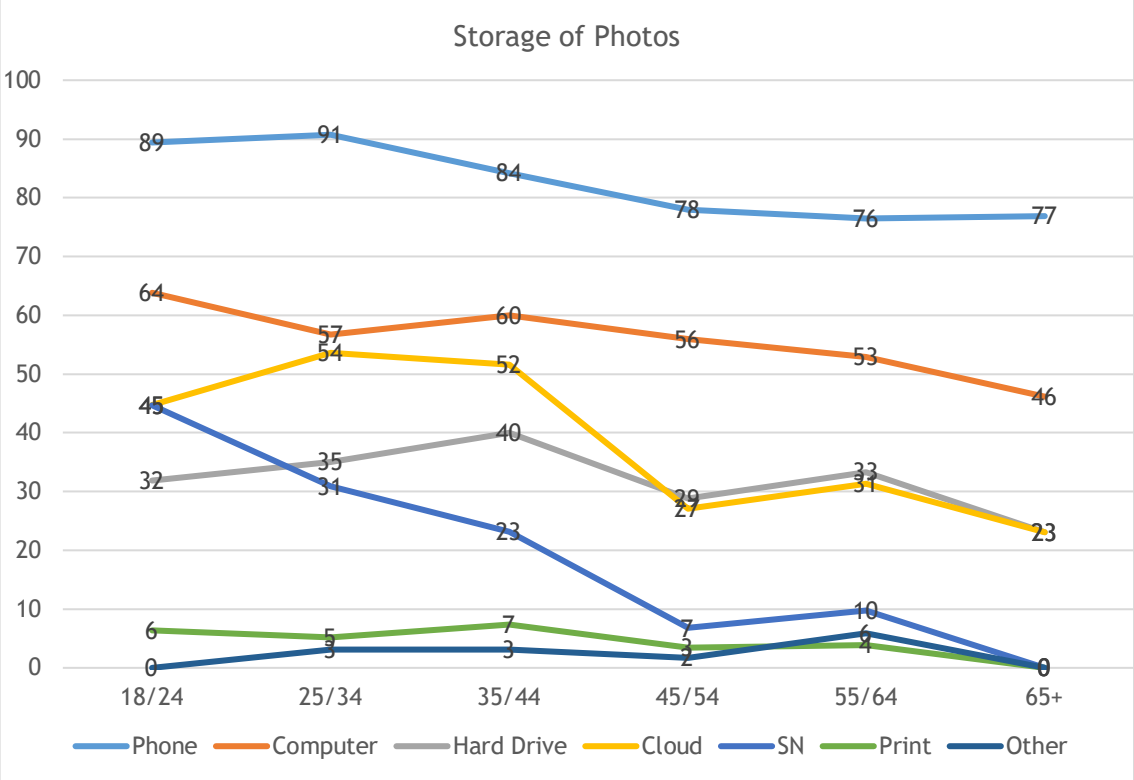

Experience with Smartphone by Age
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
<2
2/5
5/8
>8

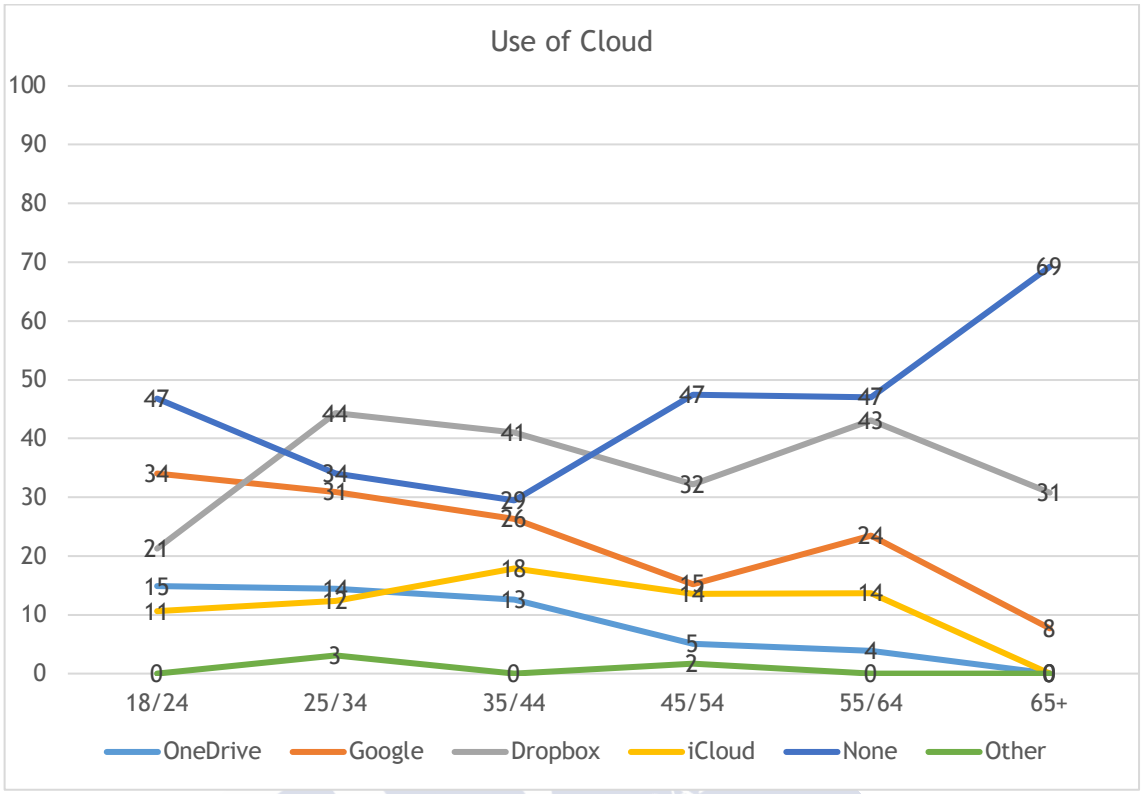

Use of Camera by Ages
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
Events
Notes
Conversation
Document
Share
Other

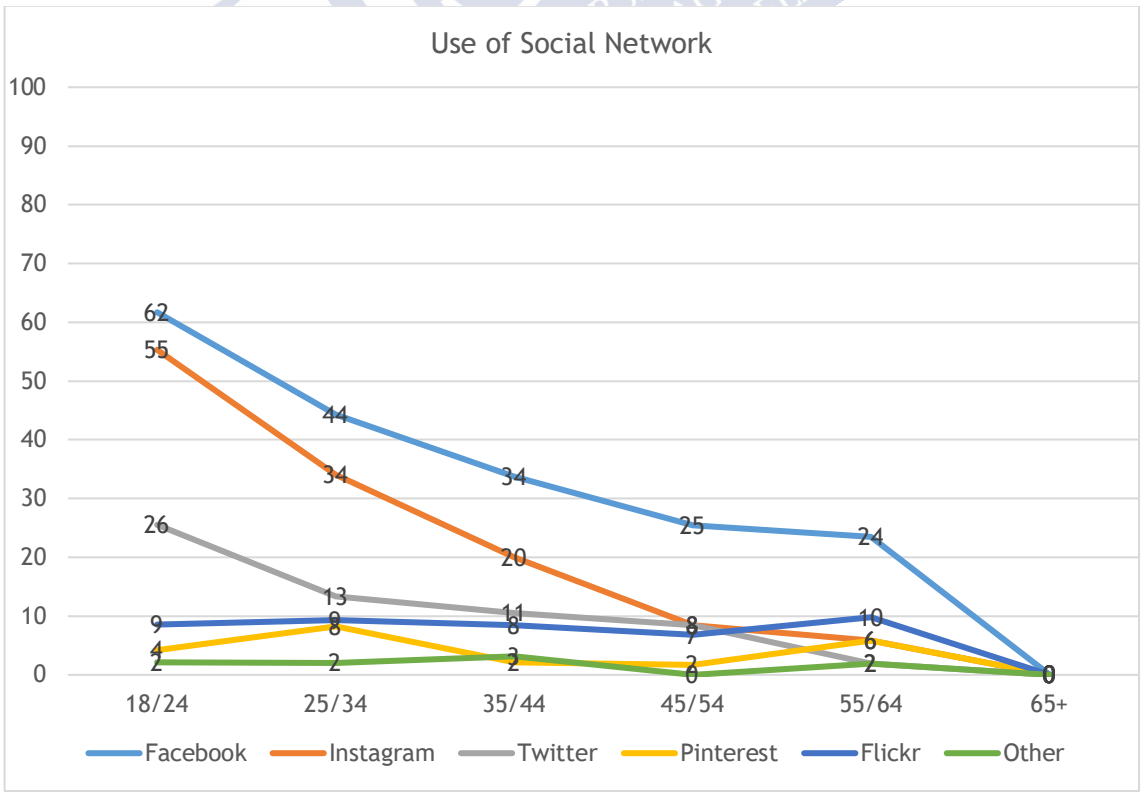

Nº of Camera Uses by Age
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
1
2
3
4
5
6

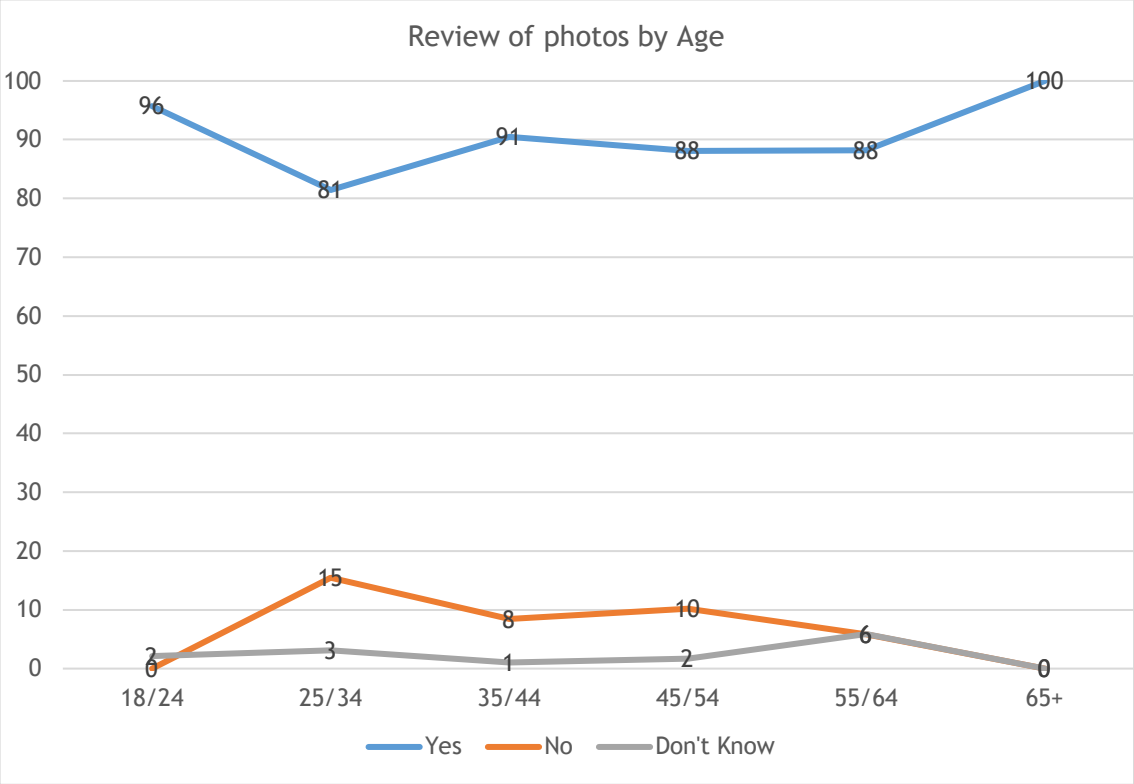

Source of Photos by Ages
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
Camera
Mail
Whatsapp
Screenshots
SN
MMS
Apps
Other

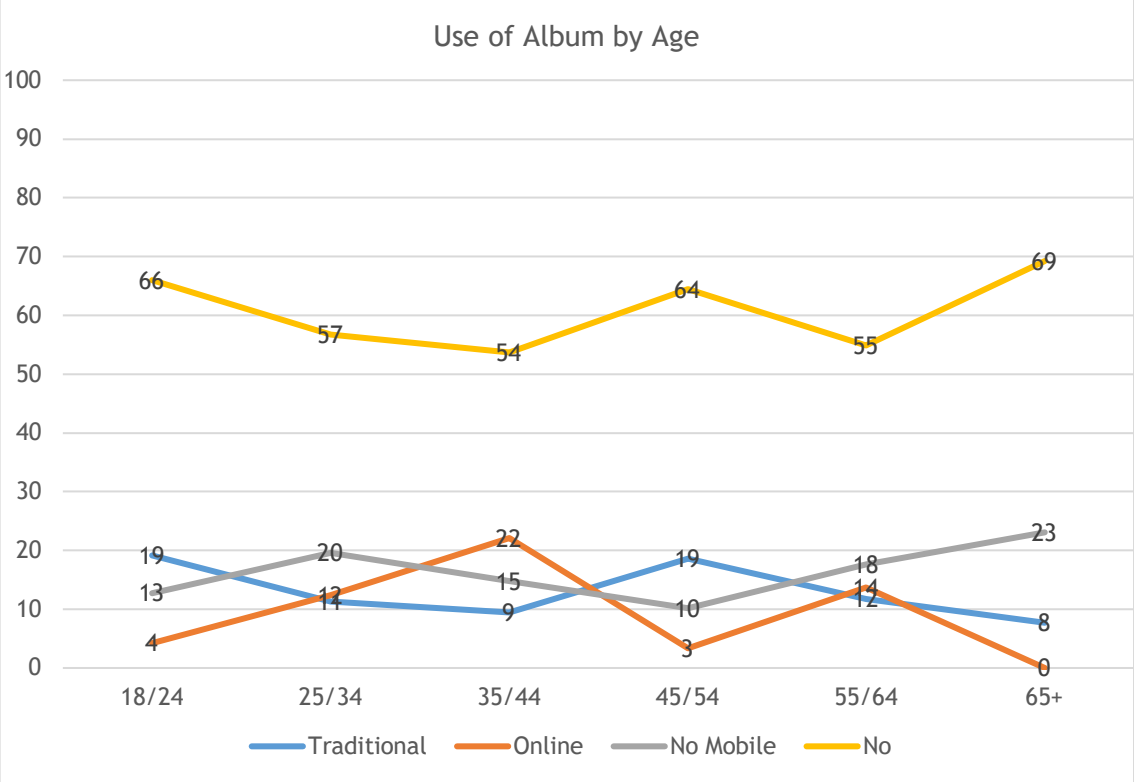

Authorship of the pictures by Age
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
Me
Family
Extended Family
Friends
Celibrities
Unknown
Other

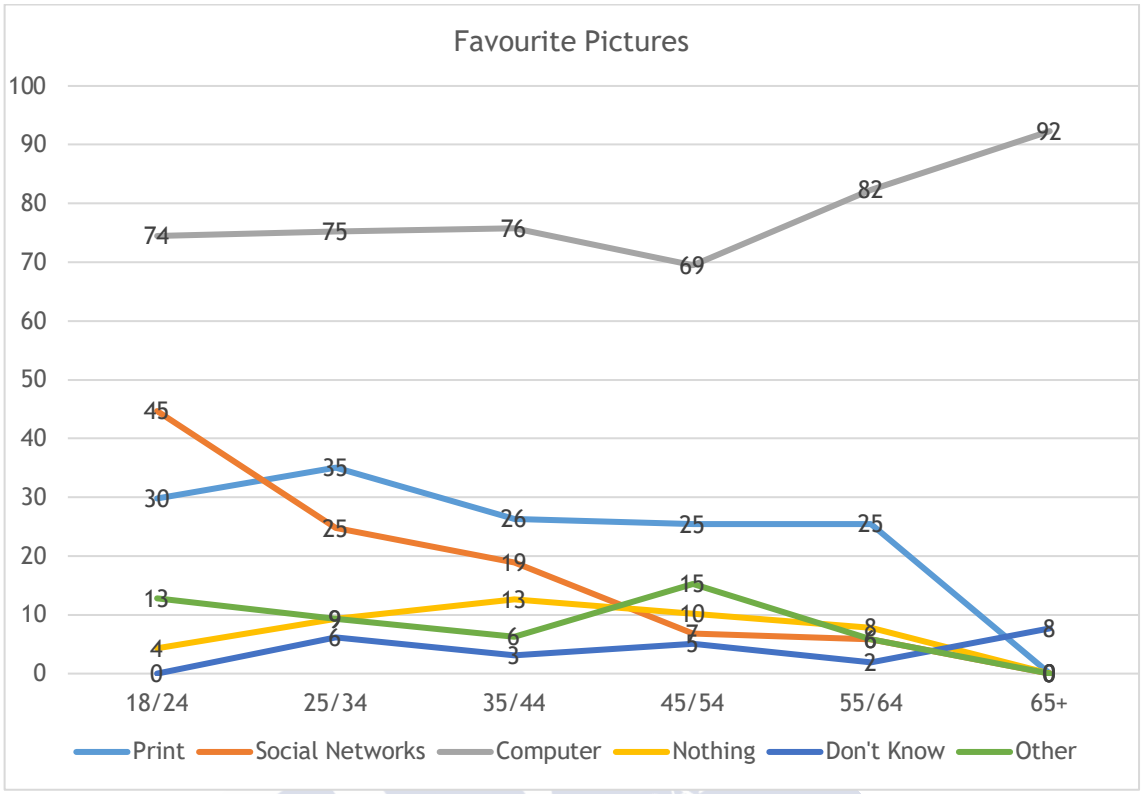

Storage of Photos
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
Phone
Computer
Hard Drive
Cloud
SN
Print
Other

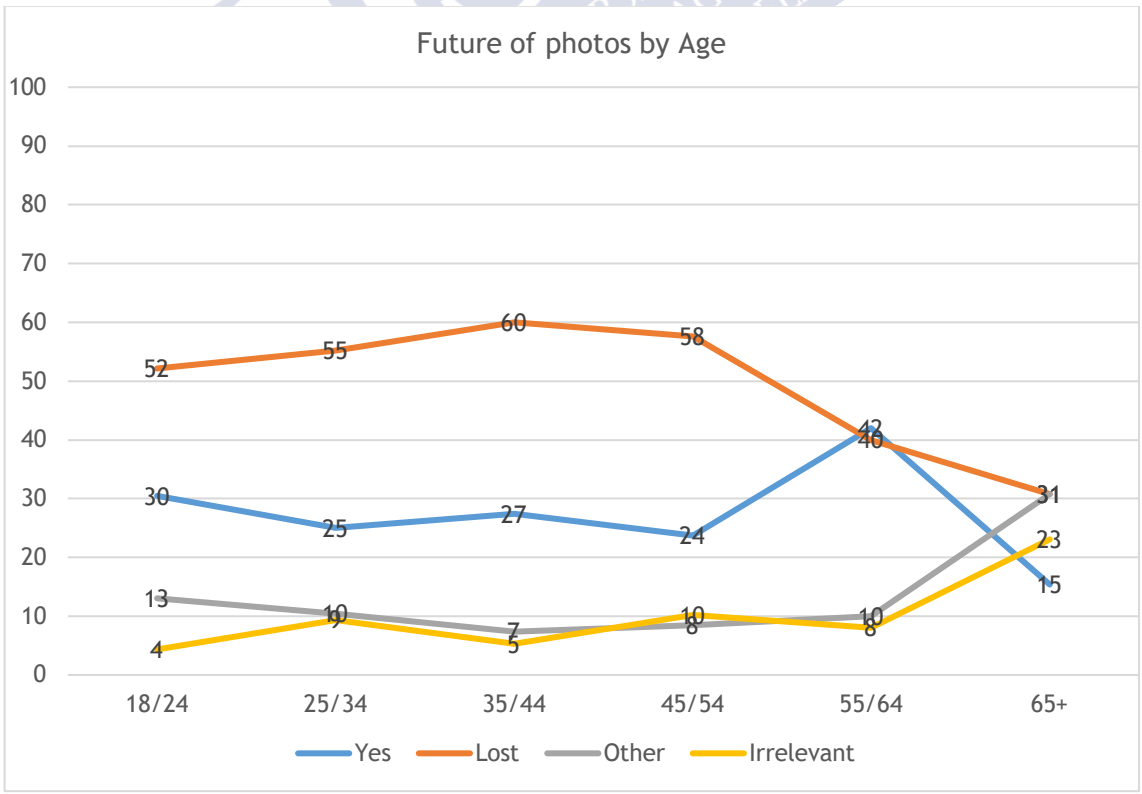

Use of Cloud
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
OneDrive
Google
Dropbox
iCloud
None
Other

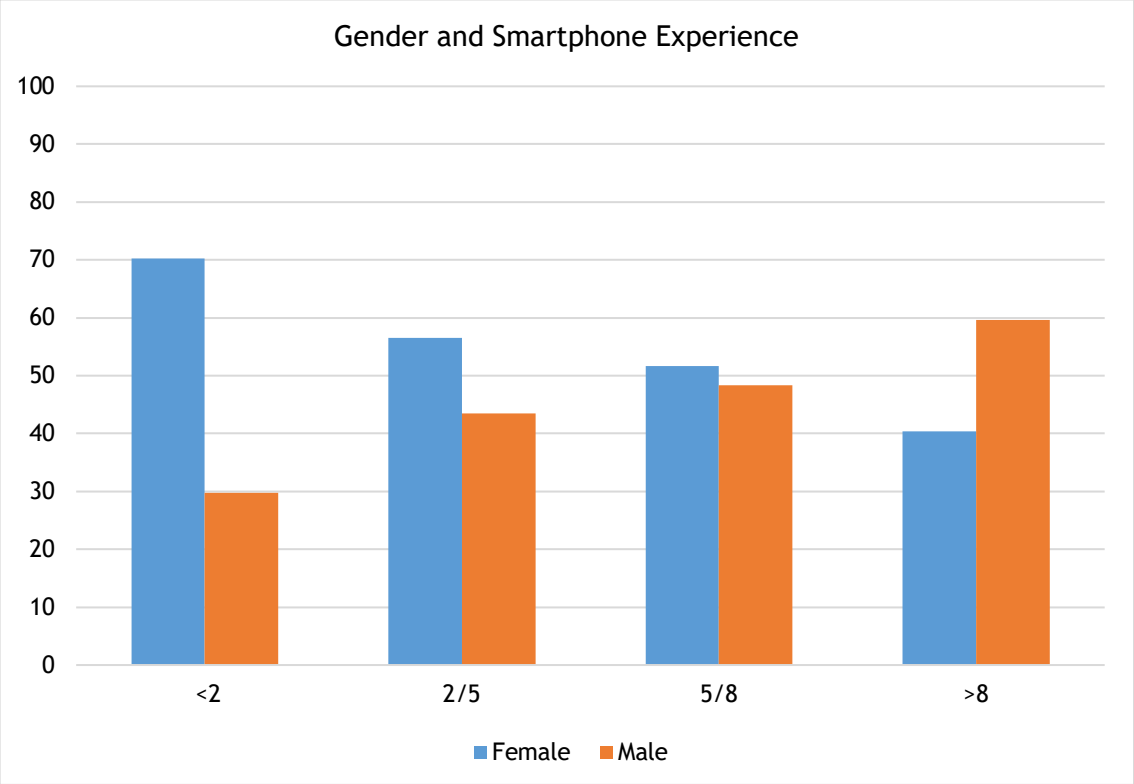

Use of Social Network
100
90
80
70
60
50
40
30
20
10
0
18/24
25/34
35/44
45/54
55/64
65+
Facebook
Instagram
Twitter
Pinterest
Flickr
Other

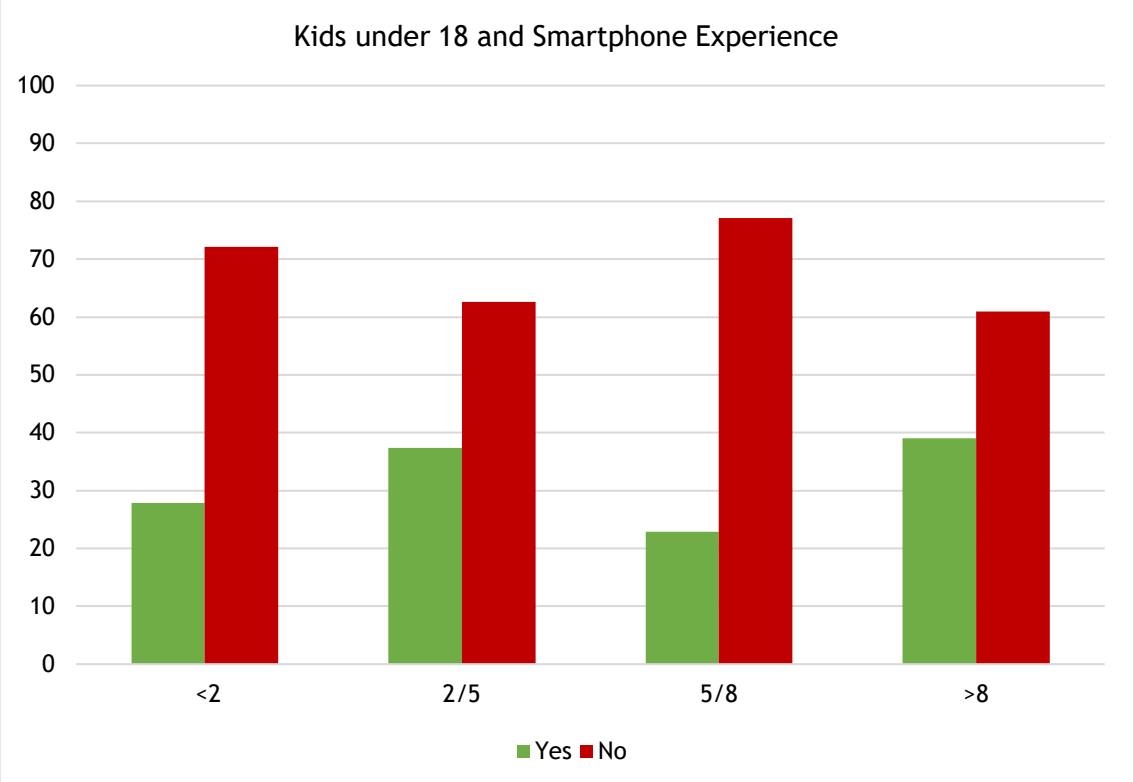

Review of photos by Age
100
90
80
70
60
50
40
30
20
10
0
96
81
91
88
88
100
2
15
8
10
6
0
0
3
1
2
0
18/24
25/34
35/44
45/54
55/64
65+
Yes
No
Don't Know

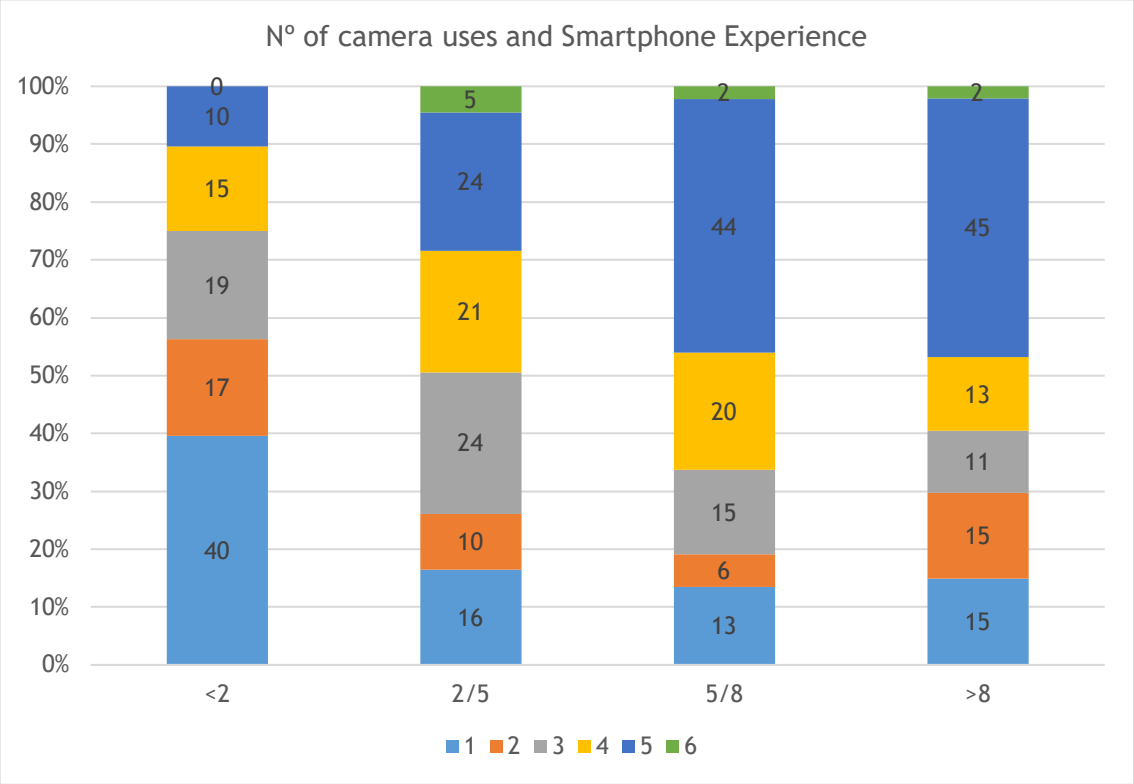

Use of Album by Age
100
90
80
70
60
50
40
30
20
10
0
66
57
54
64
55
69
19
13
4
20
12
22
15
9
19
10
3
18
14
12
23
8
0
18/24
25/34
35/44
45/54
55/64
65+
Traditional
Online
No Mobile
No

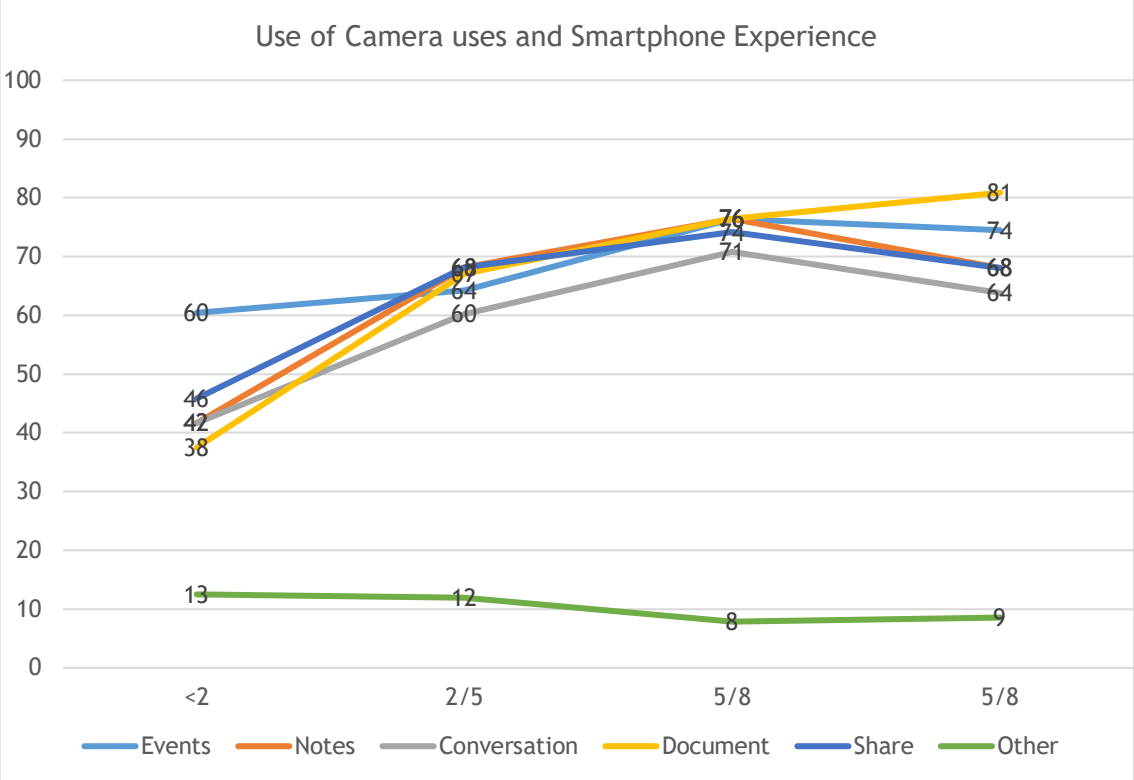

Favourite Pictures
100
90
80
70
60
50
40
30
20
10
0
74
75
76
69
82
92
45
30
35
25
26
19
25
25
13
9
13
10
15
8
4
6
3
5
2
8
0
0
18/24
25/34
35/44
45/54
55/64
65+
Print
Social Networks
Computer
Nothing
Don't Know
Other

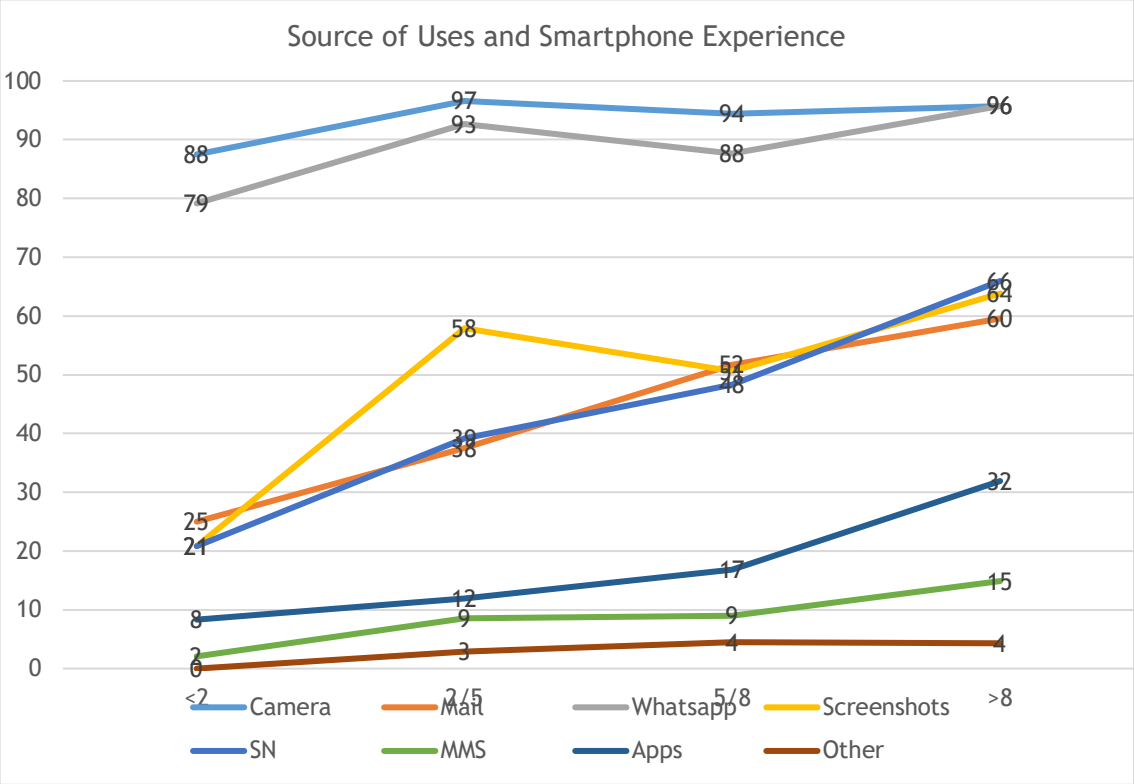

Future of photos by Age
100
90
80
70
60
50
40
30
20
10
0
52
55
60
58
42
31
30
25
27
24
40
15
13
10
7
10
10
23
4
9
5
8
8
18/24
25/34
35/44
45/54
55/64
65+
Yes
Lost
Other
Irrelevant

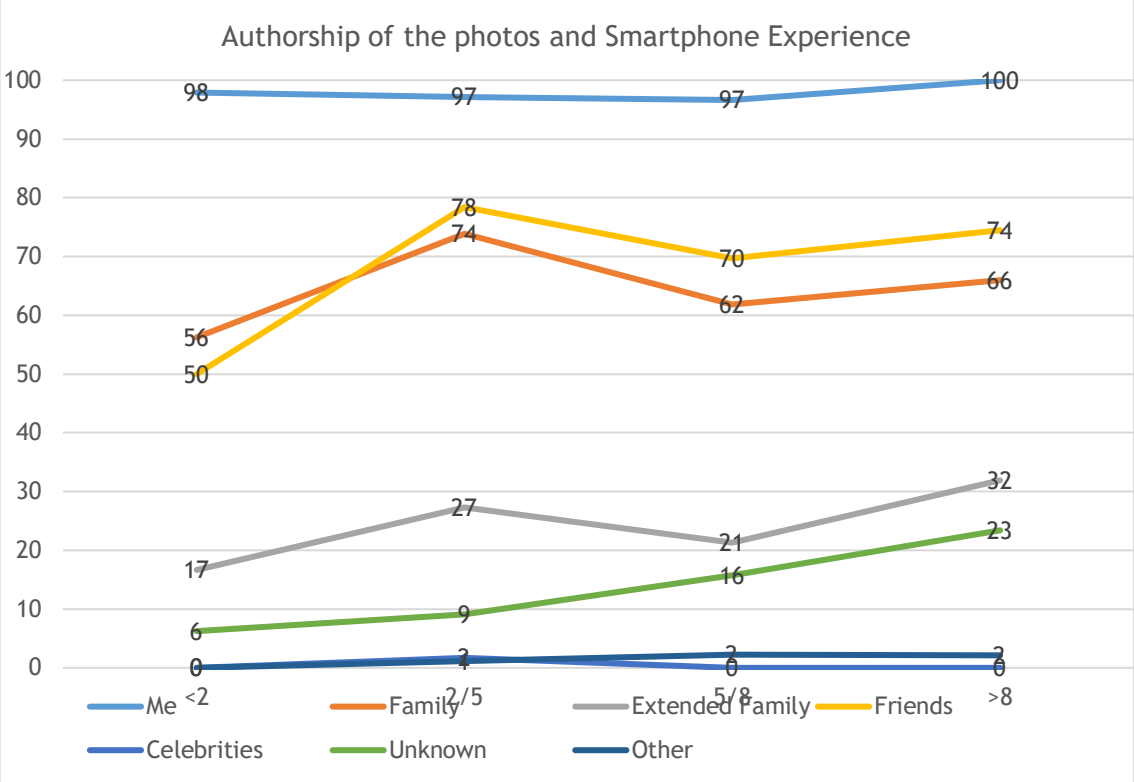

Gender and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
Female
Male

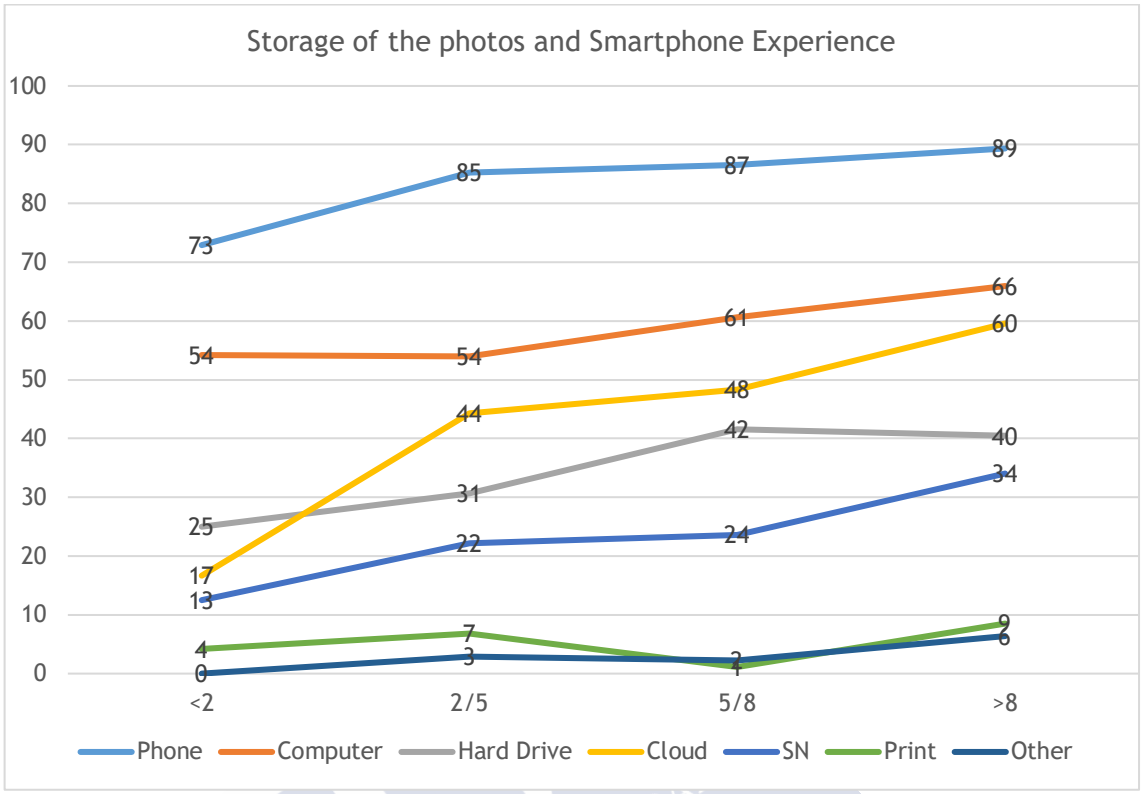

Kids under 18 and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
Yes
No

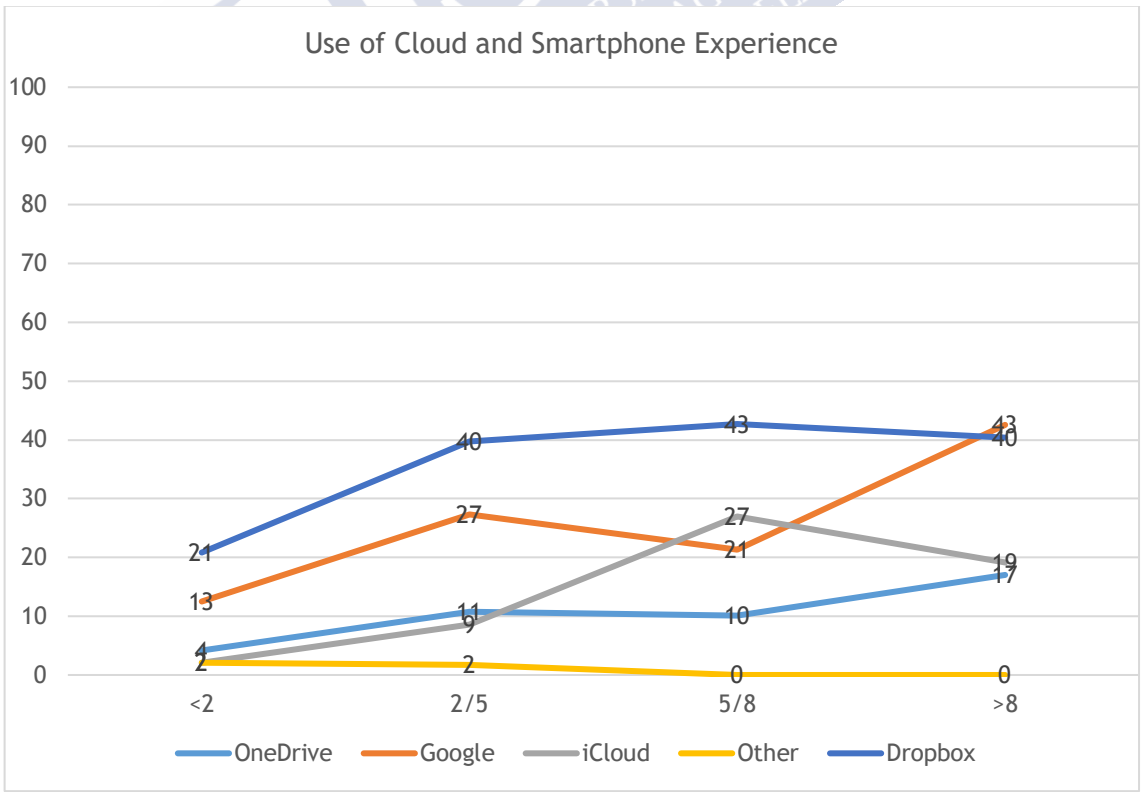

Nº of camera uses and Smartphone Experience
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
15
19
17
40
5
24
21
24
10
16
2
44
20
15
6
13
2
45
13
11
15
15
<2
2/5
5/8
>8
1 2 3 4 5 6

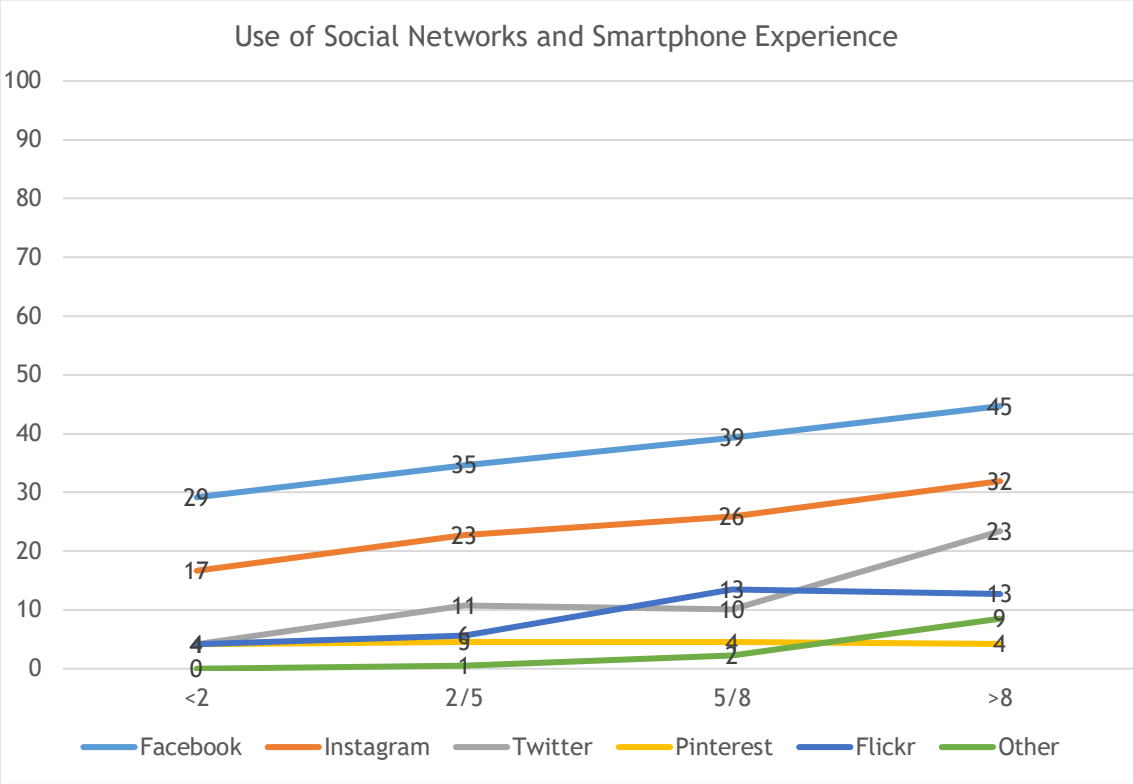

Use of Camera uses and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
60
46
42
38
13
64
60
12
76
74
71
8
81
74
68
64
9
<2
2/5
5/8
5/8
Events
Notes
Conversation
Document
Share
Other

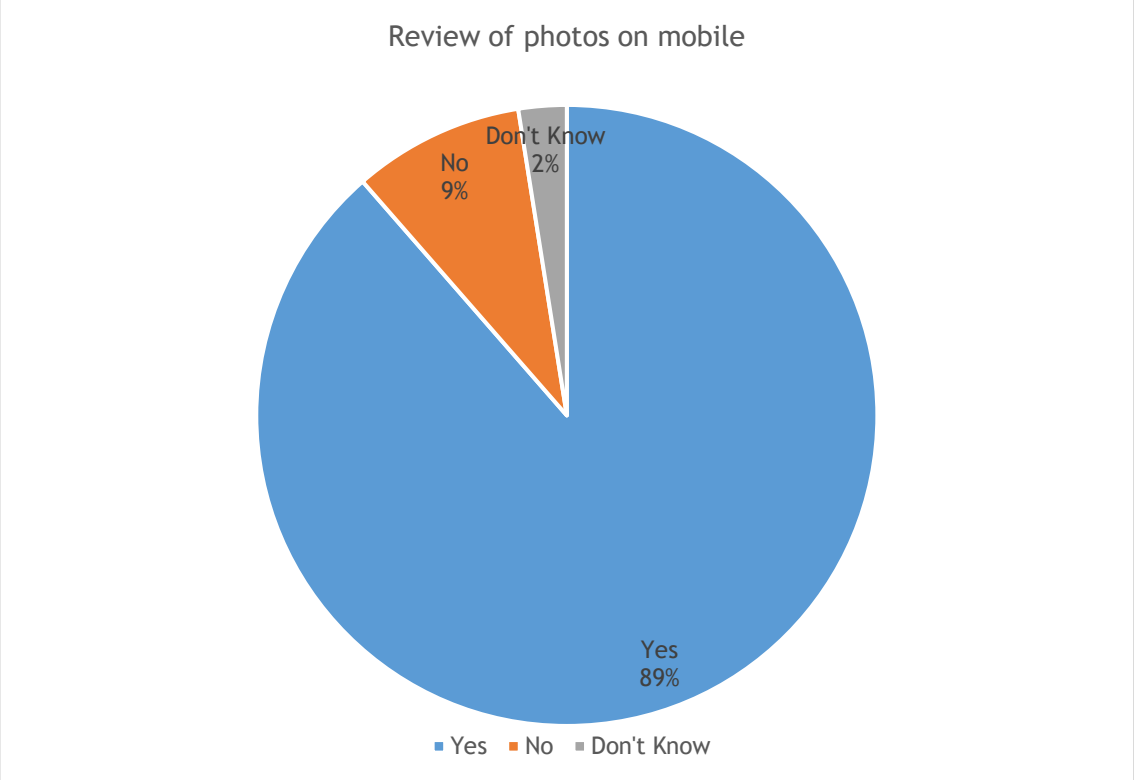

Source of Uses and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
Camera
Mail
Whatsapp
Screenshots
SN
MMS
Apps
Other

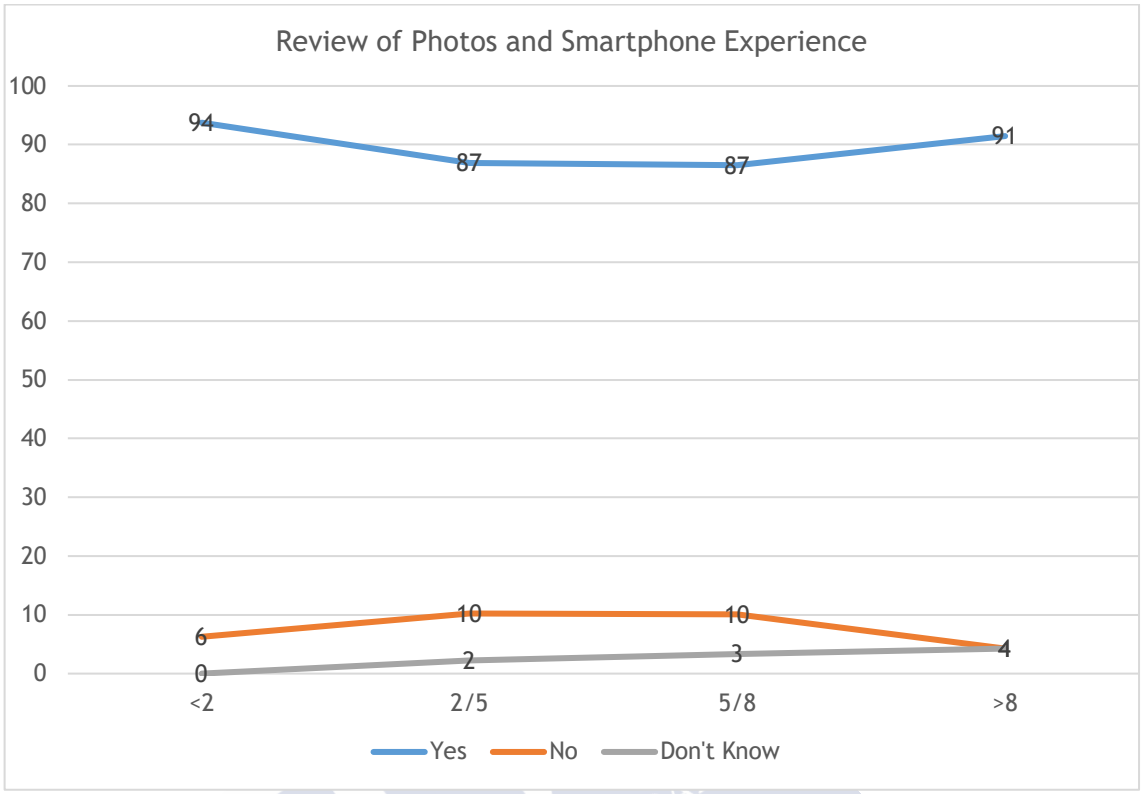

Authorship of the photos and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
Me
Family
Extended Family
Friends
Celebrities
Unknown
Other

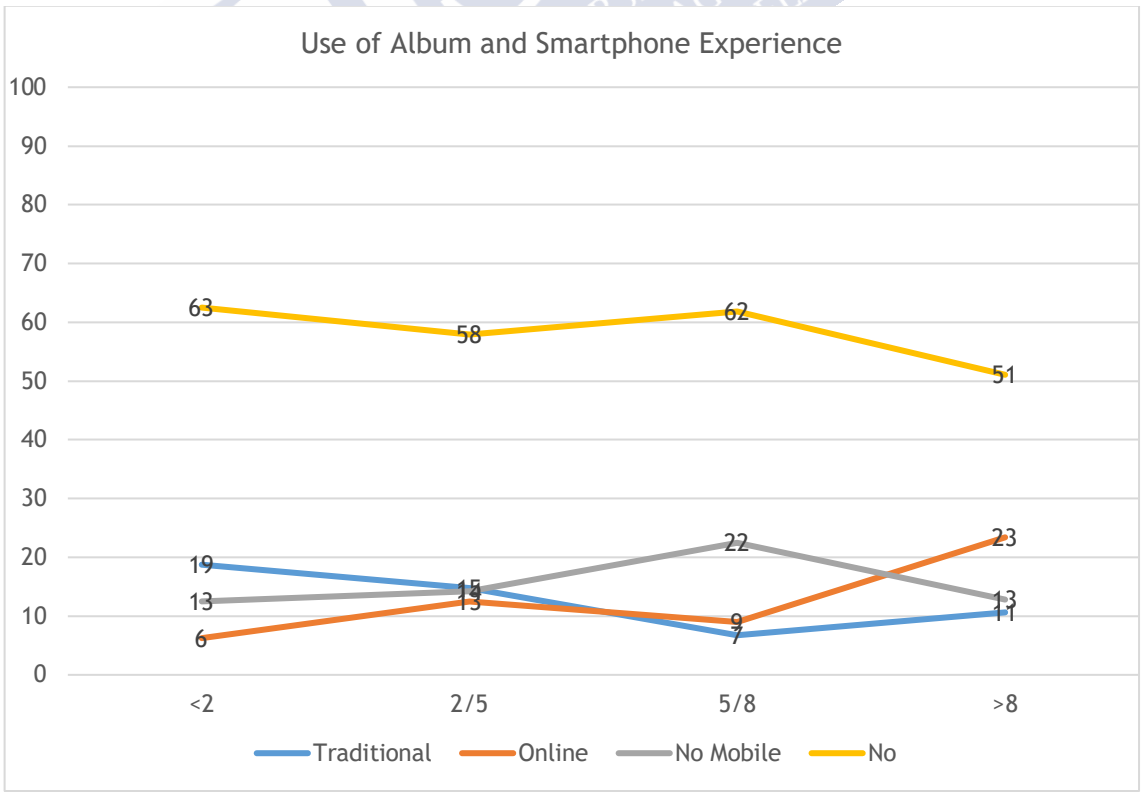

Storage of the photos and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
73
85
87
89
54
54
61
66
17
44
48
60
25
31
42
40
13
22
24
34
4
7
1
9
0
3
2
6
Phone
Computer
Hard Drive
Cloud
SN
Print
Other

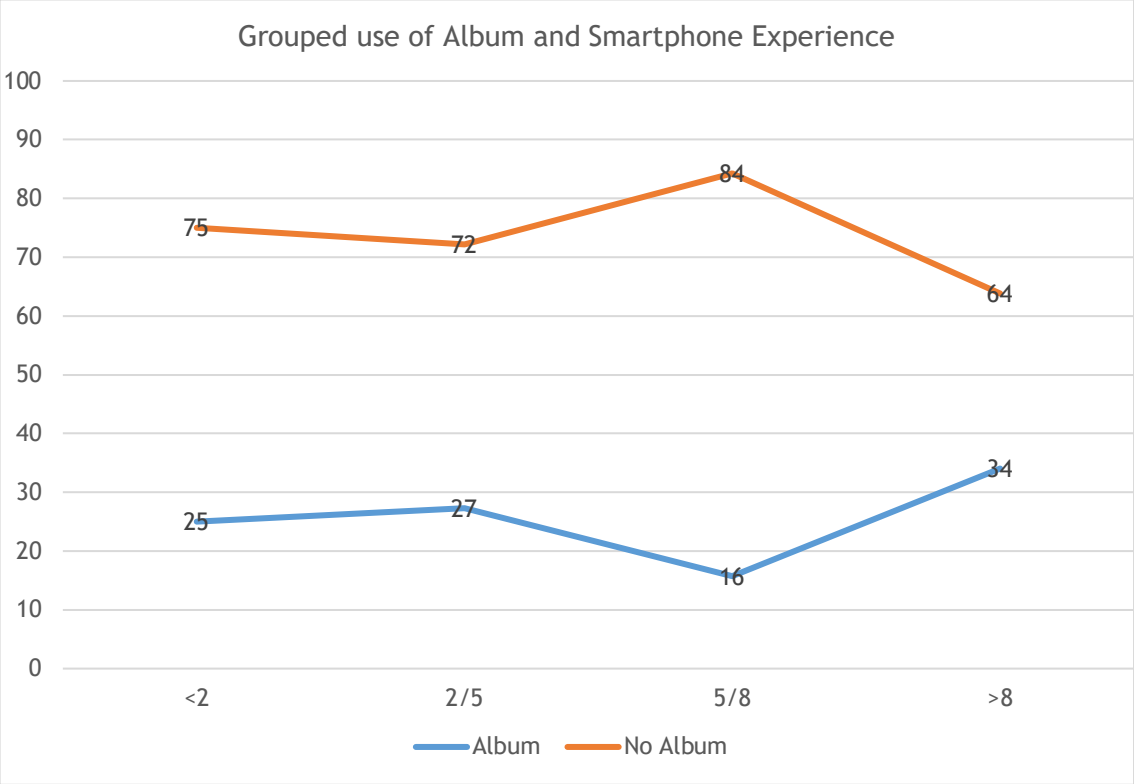

Use of Cloud and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
21
40
43
40
13
27
21
19
4
11
10
17
2
2
0
0
OneDrive
Google
iCloud
Other
Dropbox

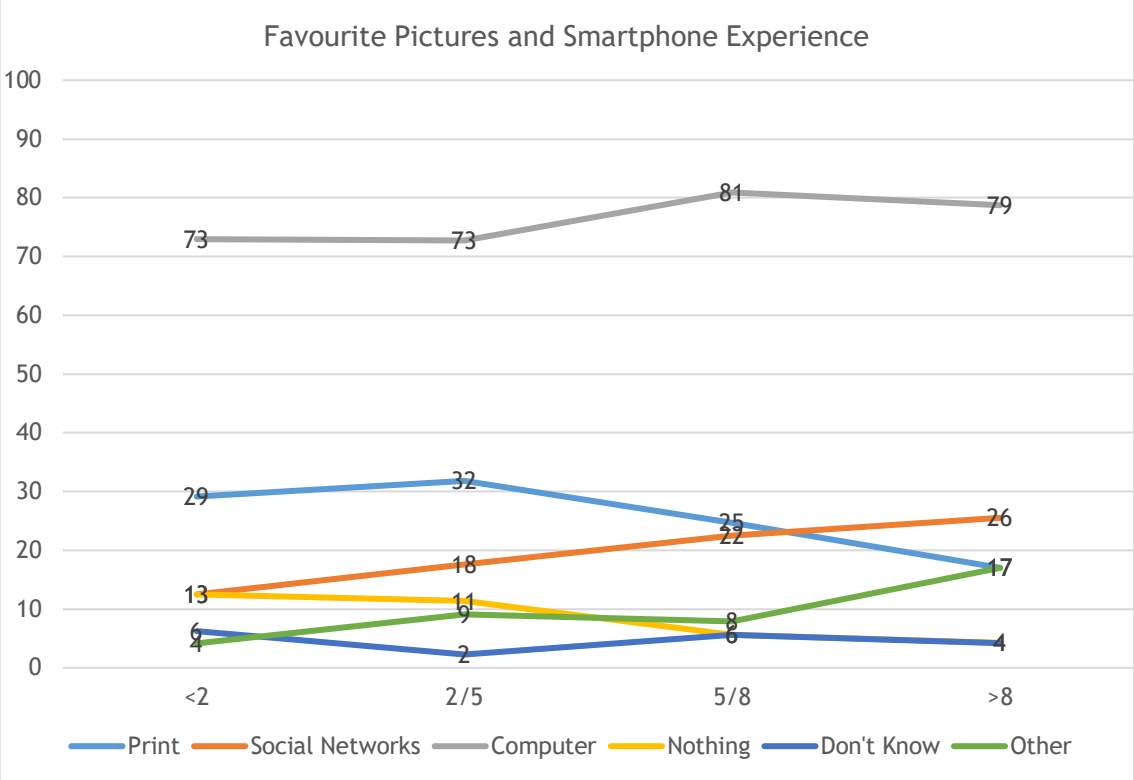

Use of Social Networks and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
29
35
39
45
17
23
26
32
4
11
10
23
4
9
13
13
0
1
2
9
4
4
4
<2
2/5
5/8
>8
Facebook
Instagram
Twitter
Pinterest
Flickr
Other

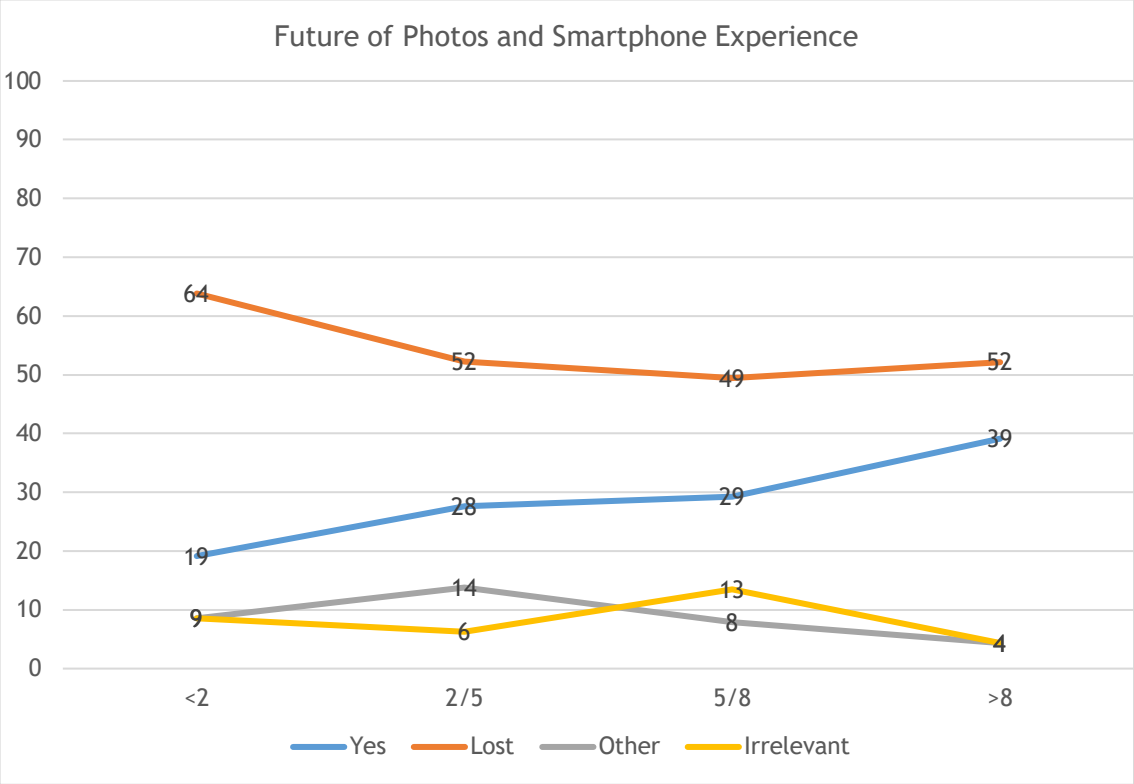

Review of photos on mobile
Don't Know
2%
No
9%
Yes
89%
Yes
No
Don't Know

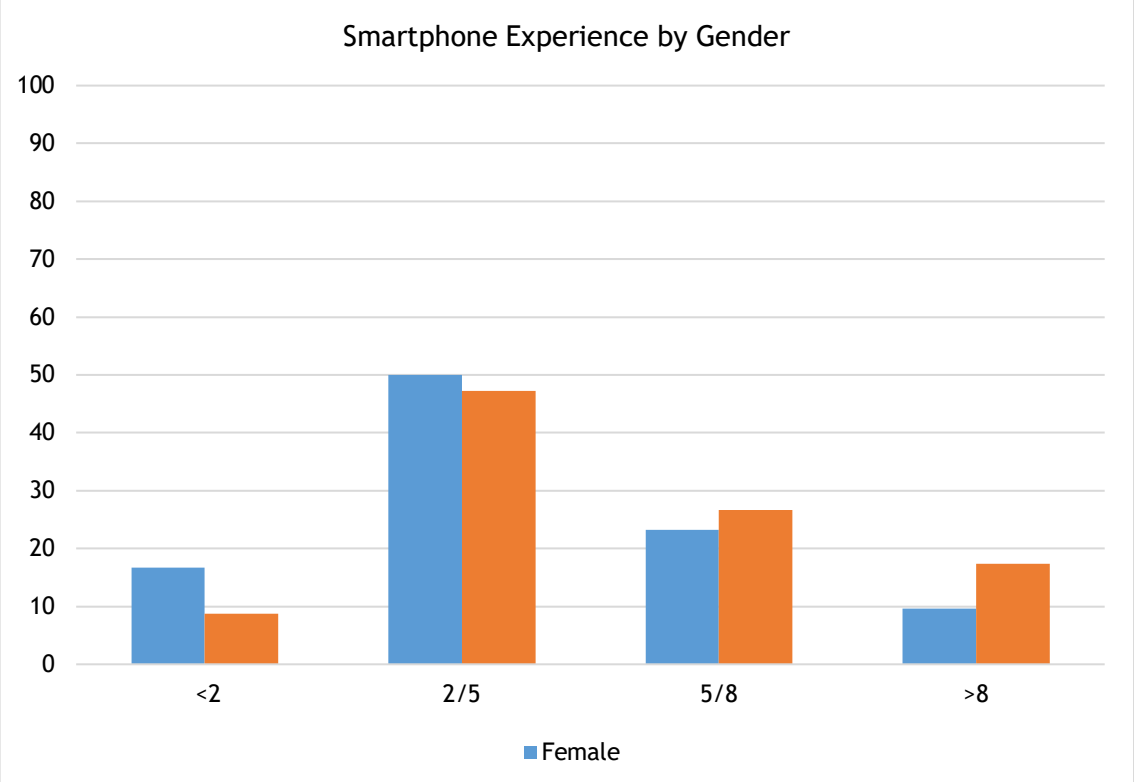

Review of Photos and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
94
87
87
91
6
10
10
4
0
2
3
<2
2/5
5/8
>8
Yes
No
Don't Know

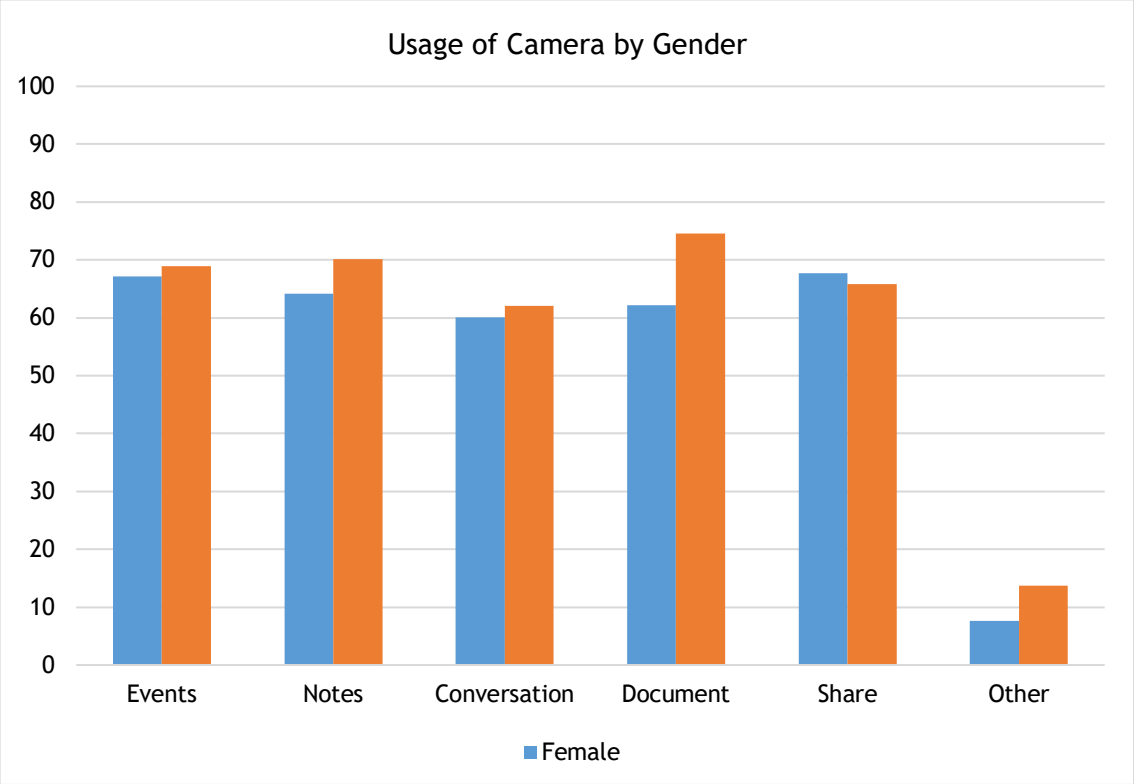

Use of Album and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
63
58
62
51
19
15
7
11
13
13
22
13
6
9
23
<2
2/5
5/8
>8
Traditional
Online
No Mobile
No

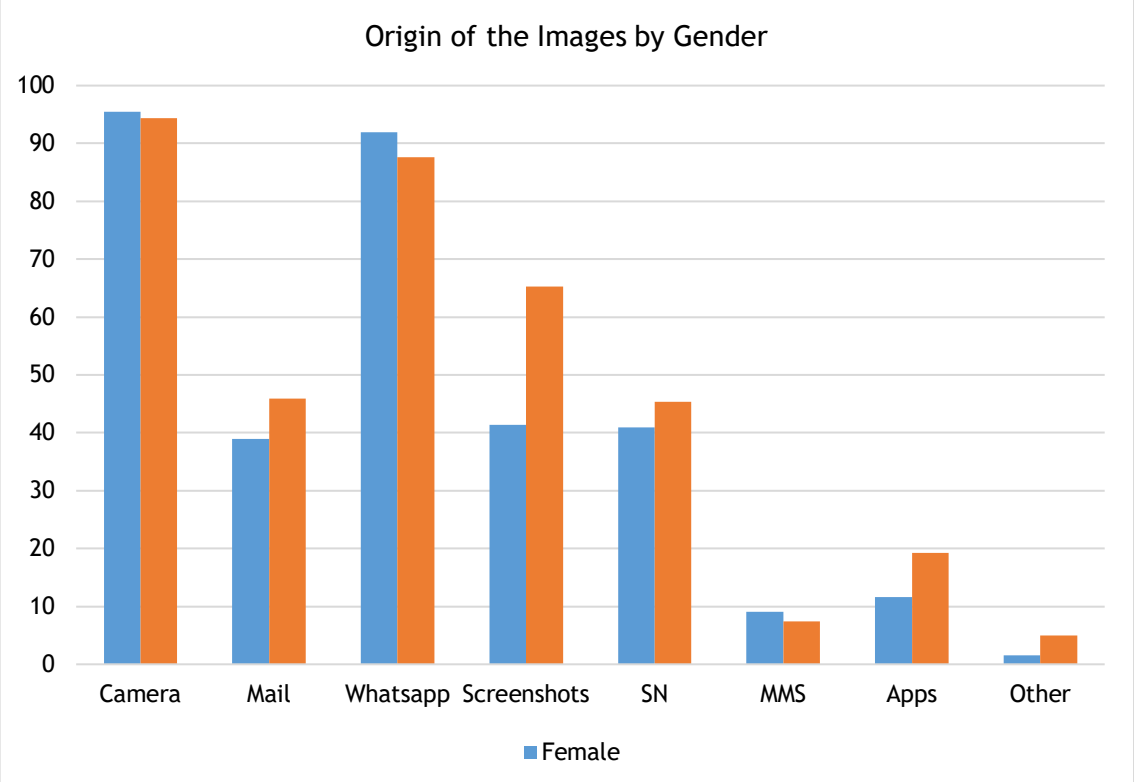

Grouped use of Album and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
75
72
84
64
25
27
16
34
<2
2/5
5/8
>8
Album
No Album

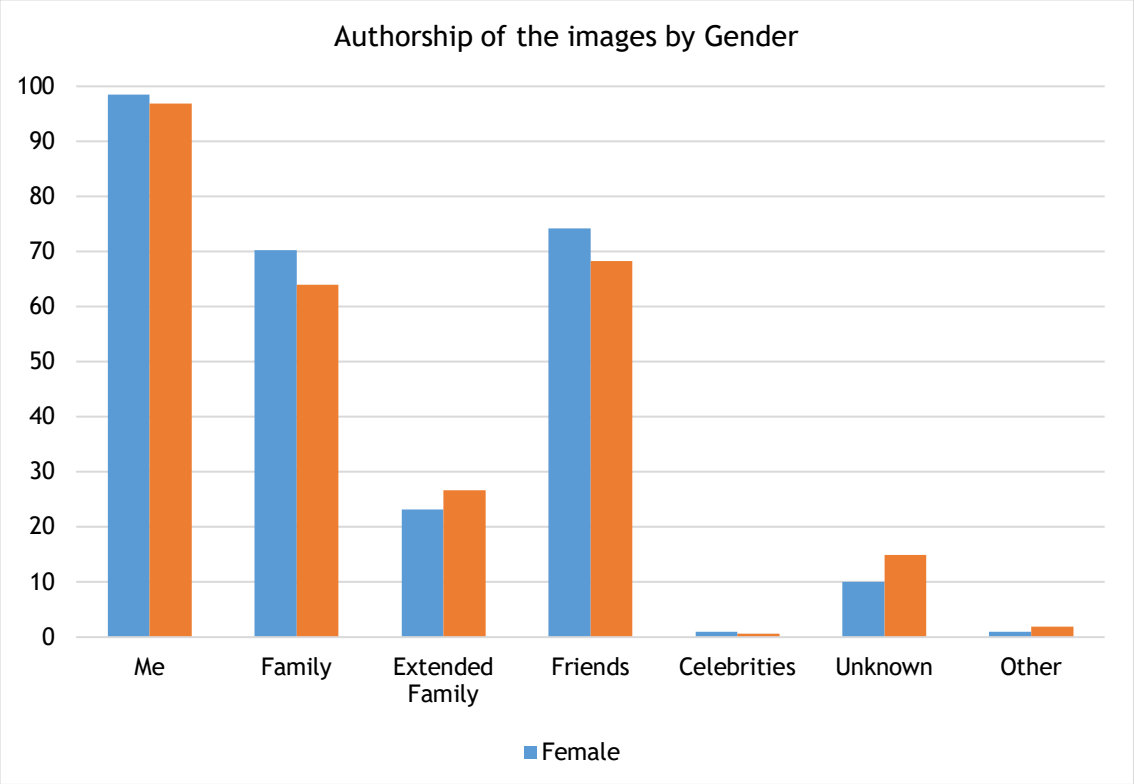

Favourite Pictures and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
73
73
81
79
29
32
25
17
13
18
22
26
11
9
8
6
4
2
6
4
<2
2/5
5/8
>8
Print
Social Networks
Computer
Nothing
Don't Know
Other

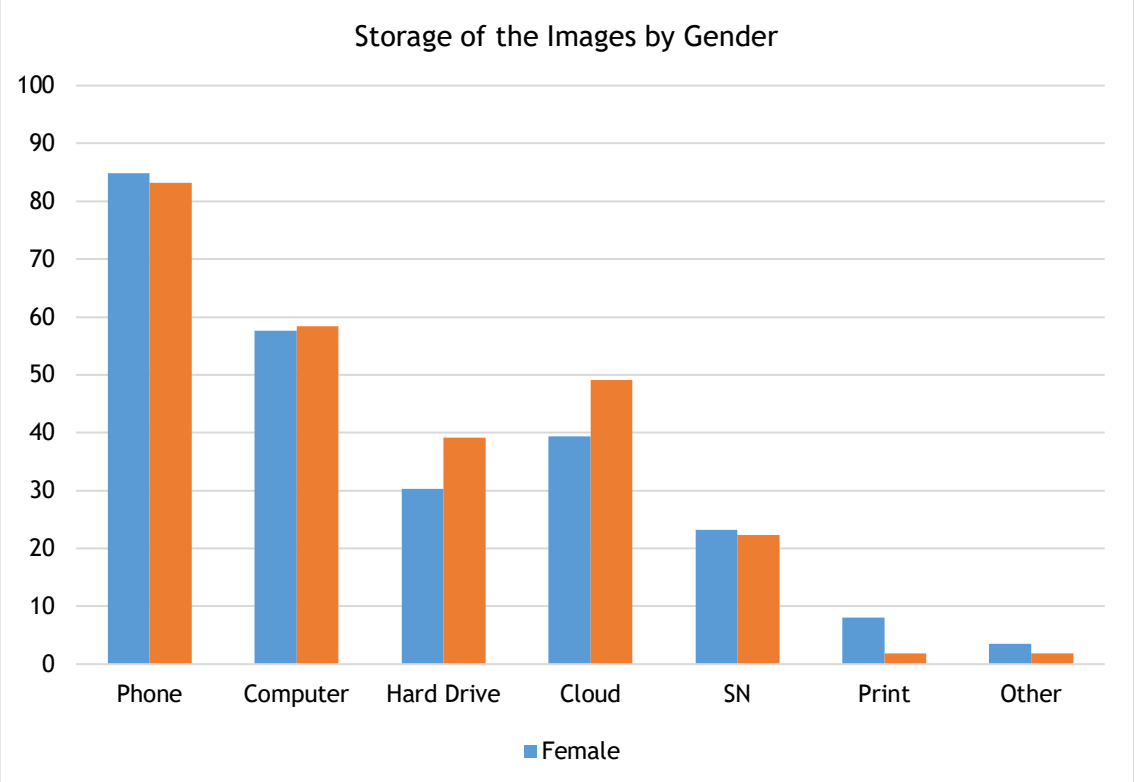

Future of Photos and Smartphone Experience
100
90
80
70
60
50
40
30
20
10
0
64
52
49
52
39
28
29
19
14
13
9
6
8
4
<2
2/5
5/8
>8
Yes
Lost
Other
Irrelevant

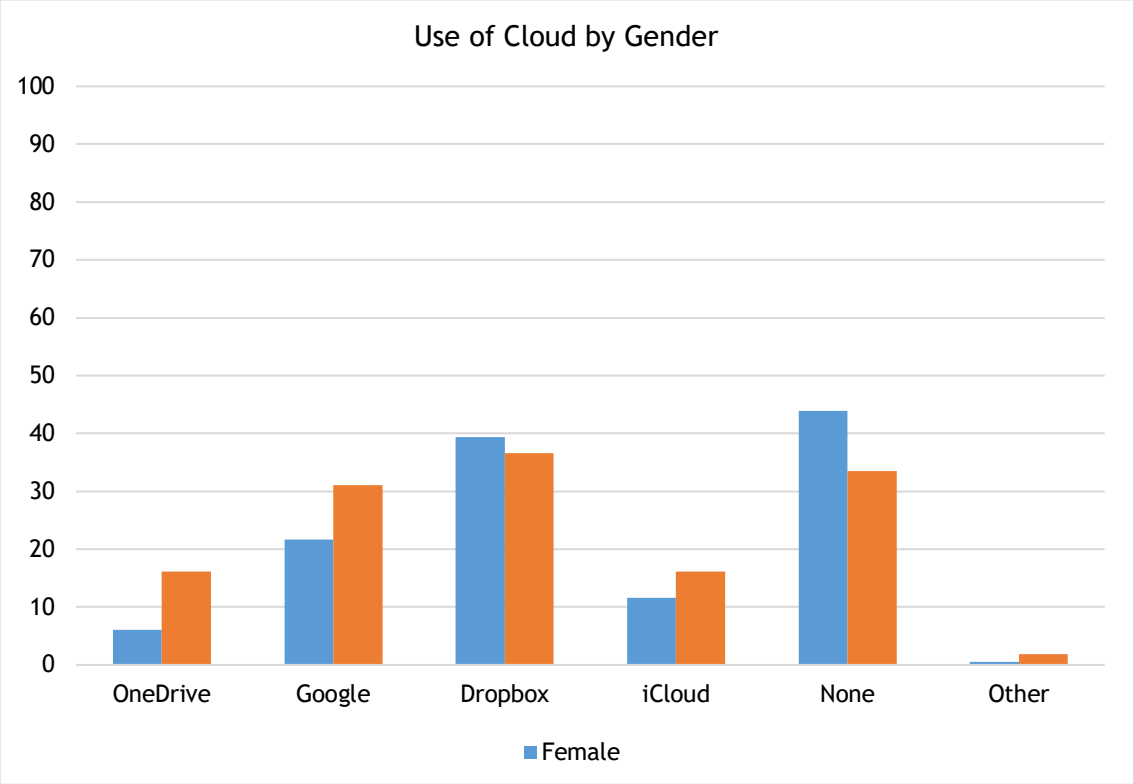

Smartphone Experience by Gender
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
Female

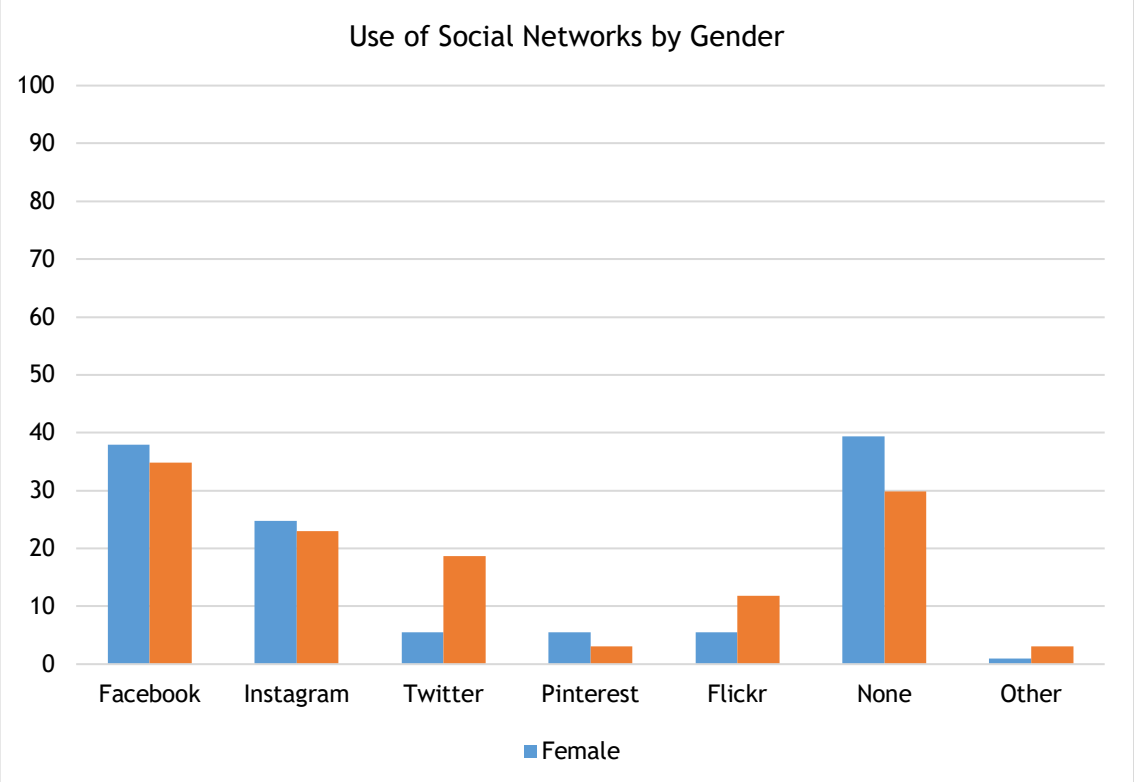

Usage of Camera by Gender
100
90
80
70
60
50
40
30
20
10
0
Events
Notes
Conversation
Document
Share
Other
Female

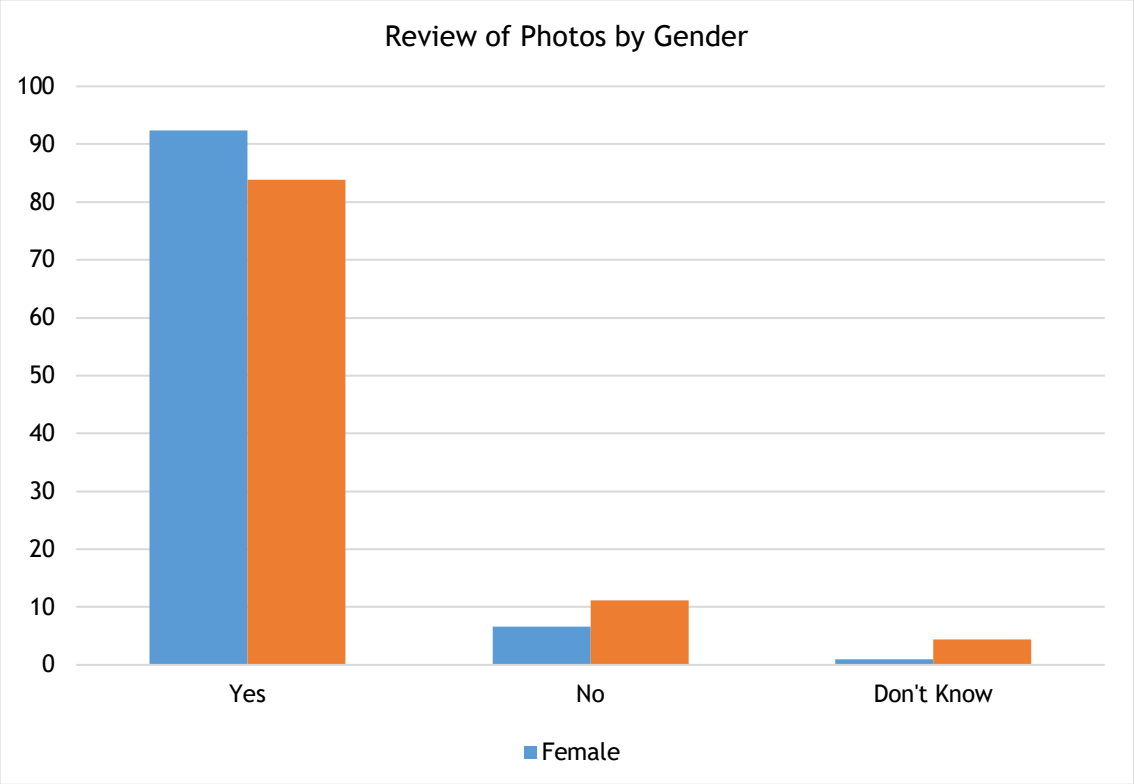

Origin of the Images by Gender
100
90
80
70
60
50
40
30
20
10
0
Camera
Mail
Whatsapp
Screenshots
SN
MMS
Apps
Other
Female

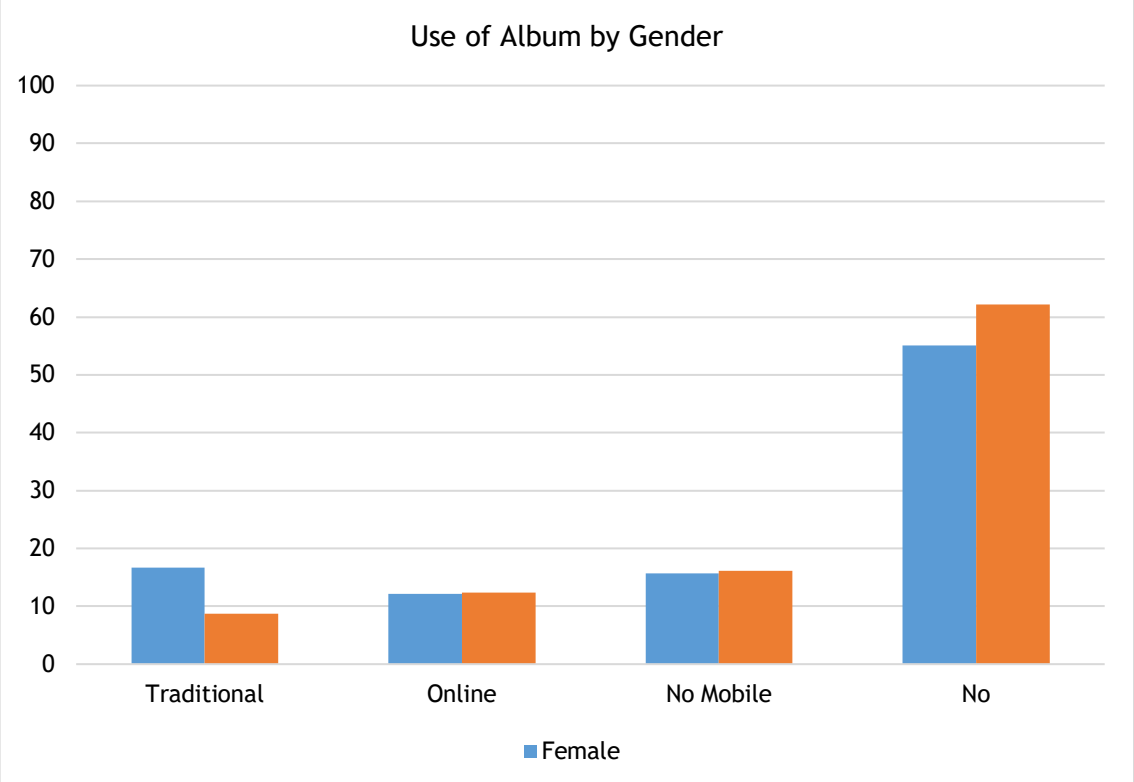

Authorship of the images by Gender
100
90
80
70
60
50
40
30
20
10
0
Me
Family
Extended Family
Friends
Celebrities
Unknown
Other
Female

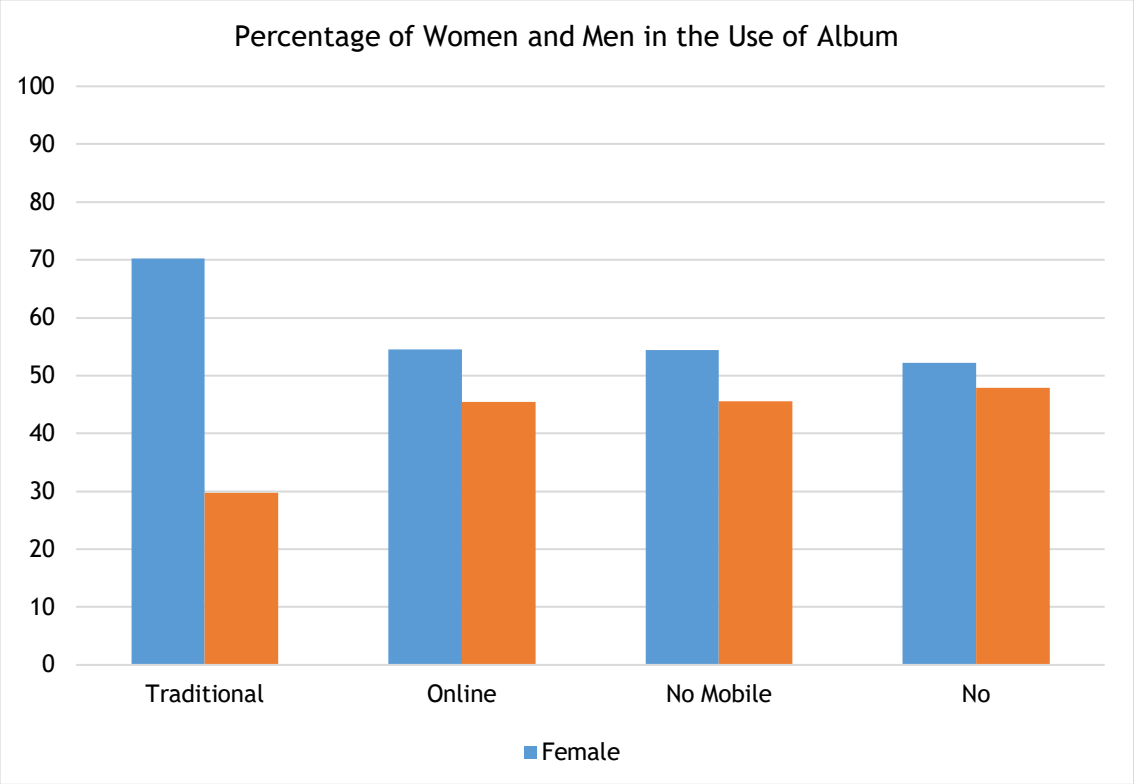

Storage of the Images by Gender
100
90
80
70
60
50
40
30
20
10
0
Phone
Computer
Hard Drive
Cloud
SN
Print
Other
Female

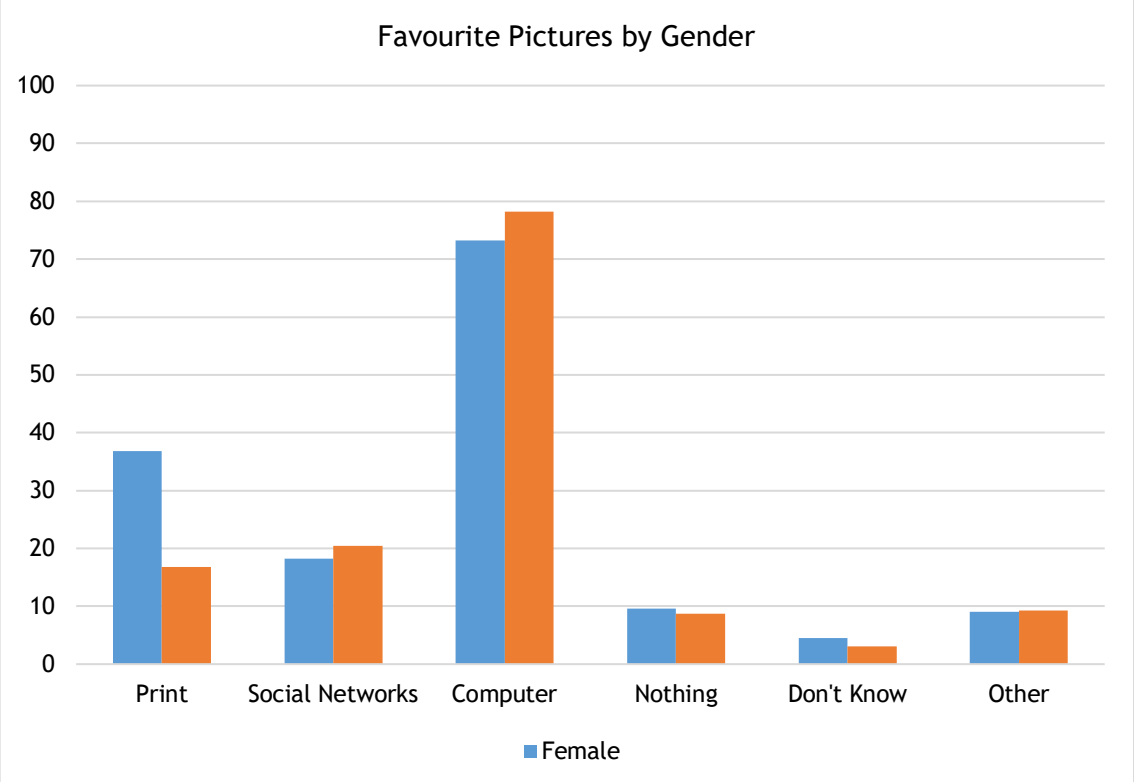

Use of Cloud by Gender
100
90
80
70
60
50
40
30
20
10
0
OneDrive
Google
Dropbox
iCloud
None
Other
Female

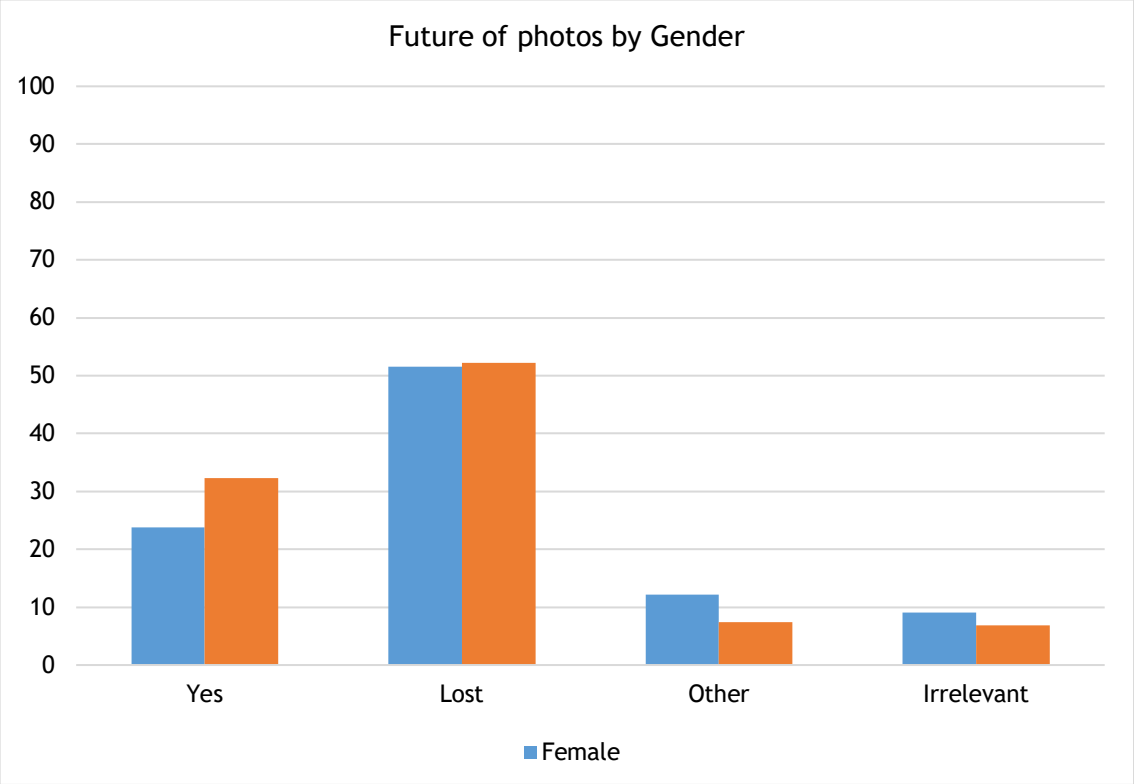

Use of Social Networks by Gender
100
90
80
70
60
50
40
30
20
10
0
Facebook
Instagram
Twitter
Pinterest
Flickr
None
Other
Female

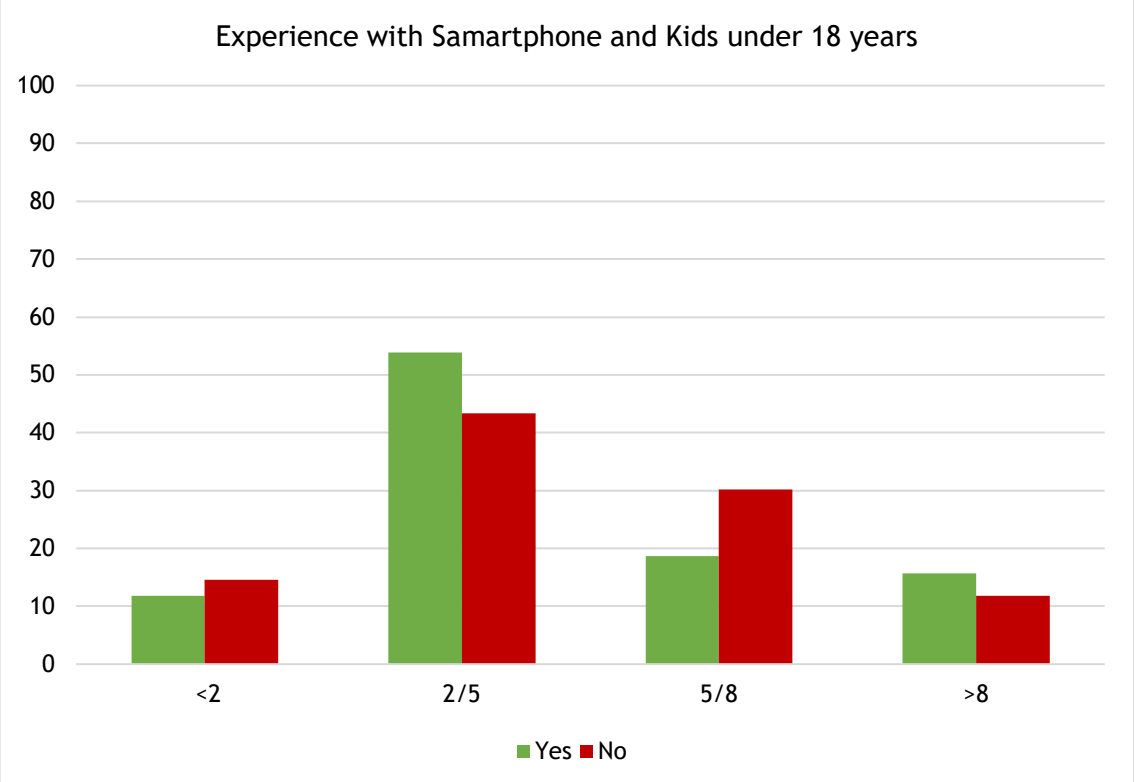

Review of Photos by Gender
100
90
80
70
60
50
40
30
20
10
0
Yes
No
Don't Know
Female

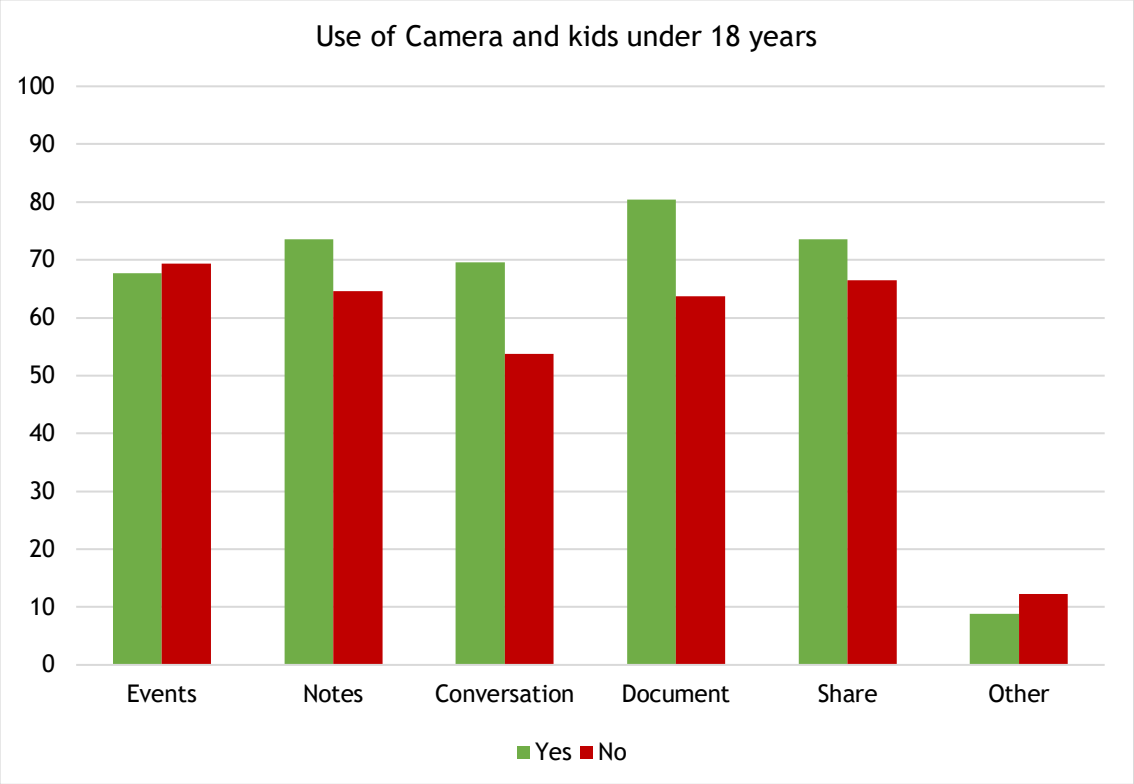

Use of Album by Gender
100
90
80
70
60
50
40
30
20
10
0
Traditional
Online
No Mobile
No
Female

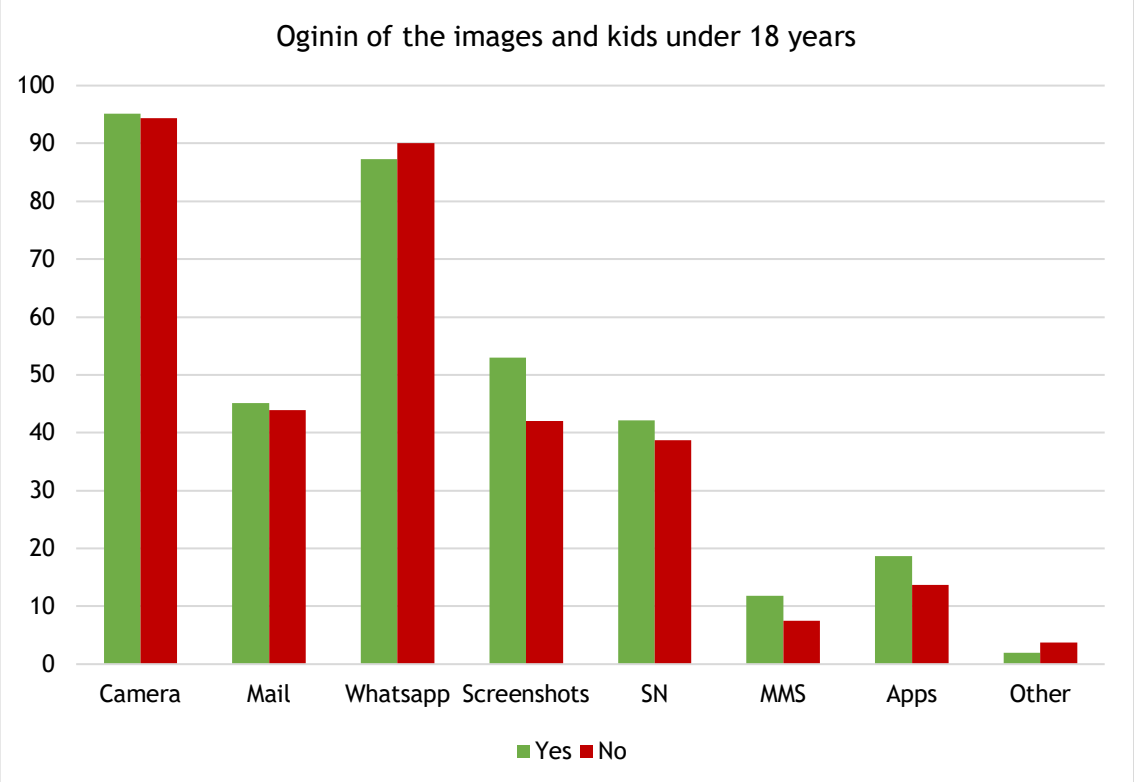

Percentage of Women and Men in the Use of Album
100
90
80
70
60
50
40
30
20
10
0
Traditional
Online
No Mobile
No
Female

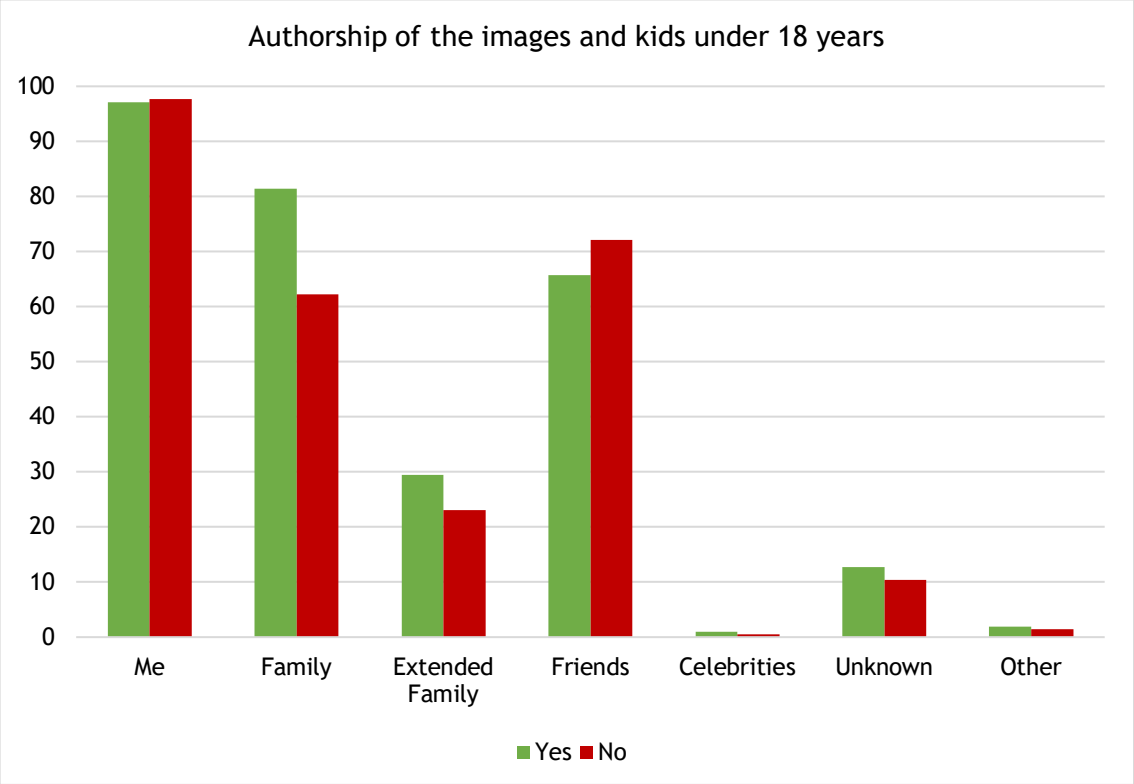

Favourite Pictures by Gender
100
90
80
70
60
50
40
30
20
10
0
Print
Social Networks
Computer
Nothing
Don't Know
Other
Female

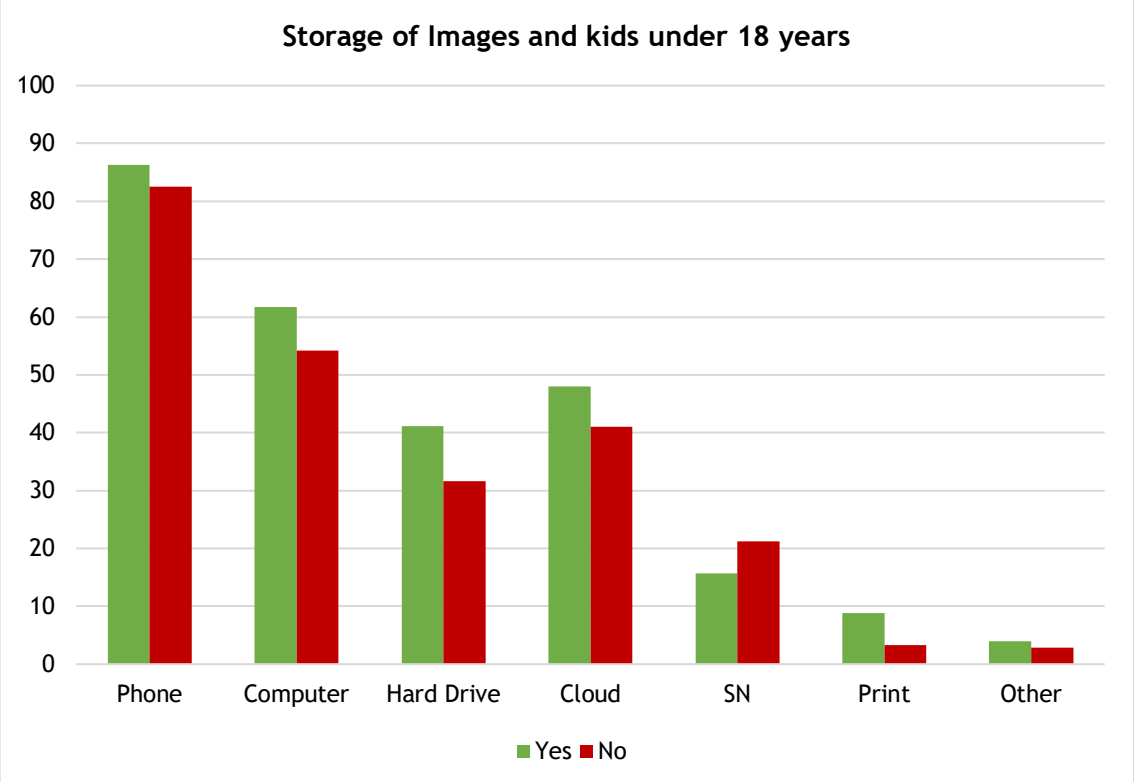

Future of photos by Gender
100
90
80
70
60
50
40
30
20
10
0
Yes
Lost
Other
Irrelevant
Female

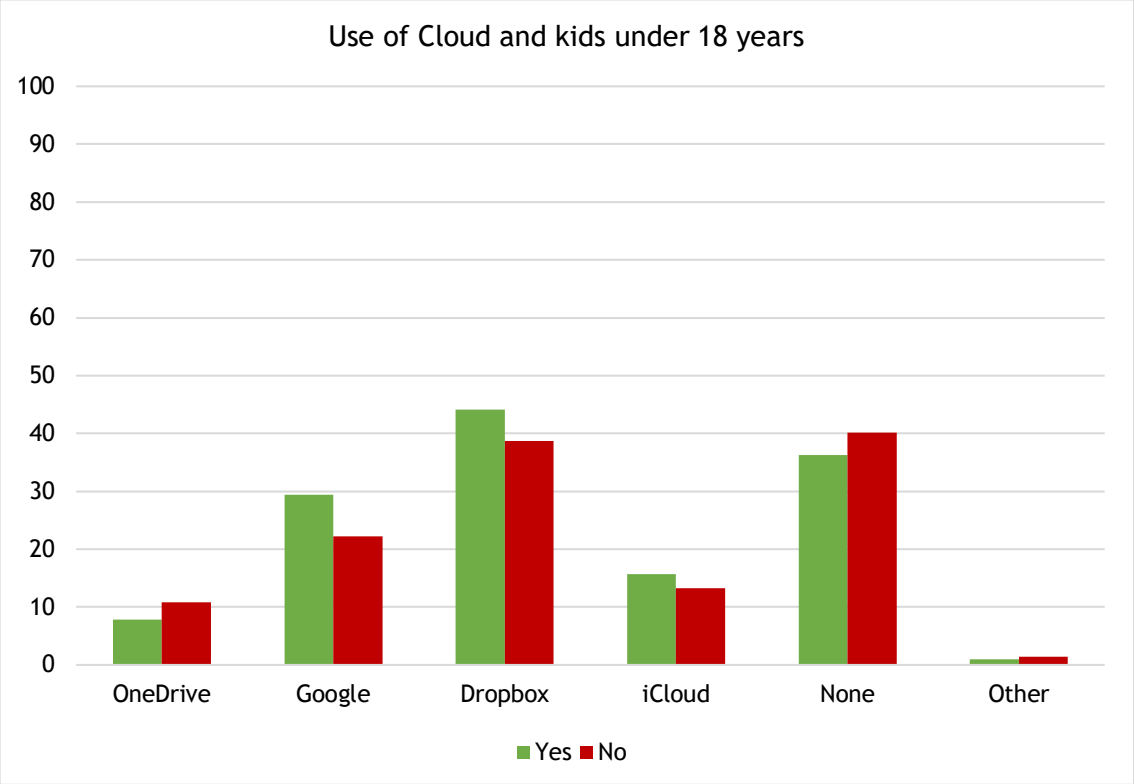

Experience with Samartphone and Kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
<2
2/5
5/8
>8
Yes
No

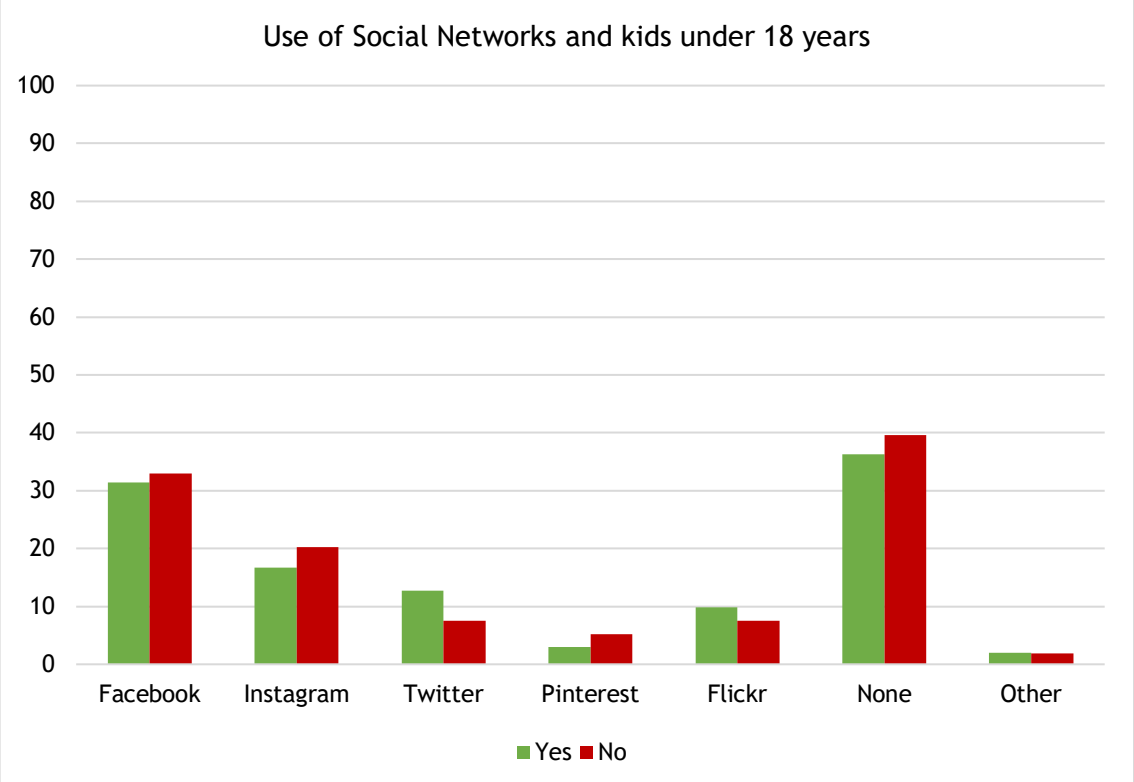

Use of Camera and kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Events
Notes
Conversation
Document
Share
Other
Yes
No

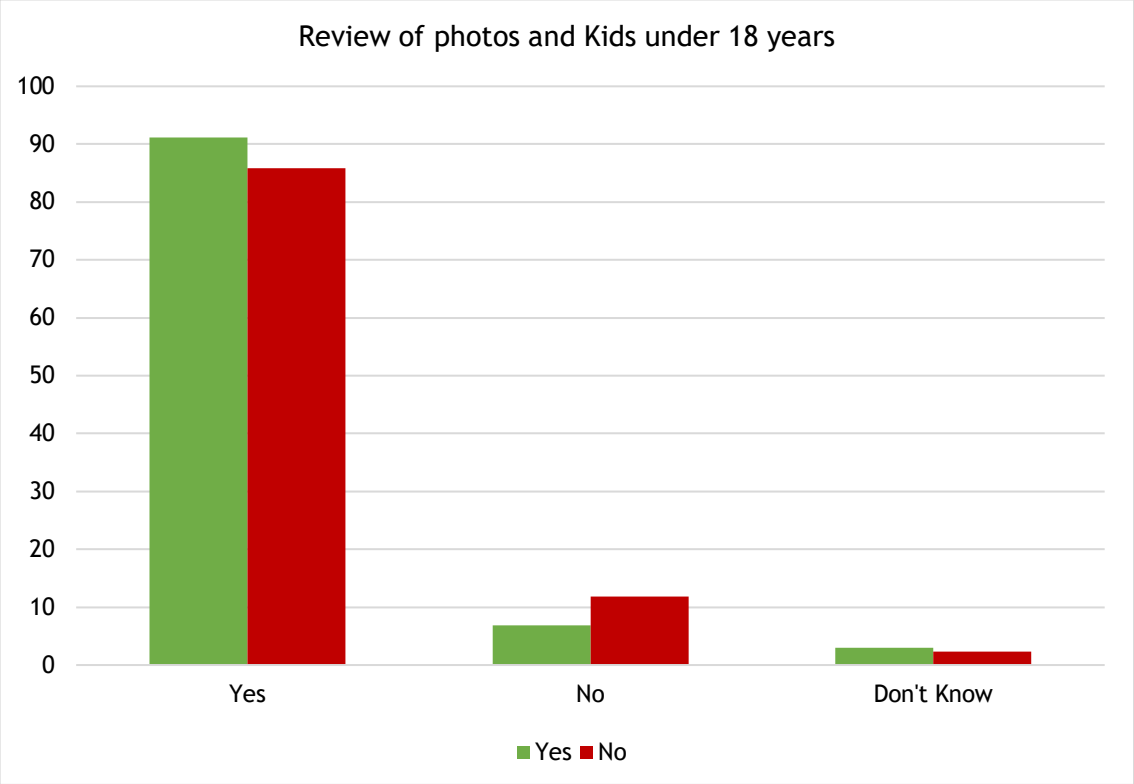

Oginin of the images and kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Camera
Mail
Whatsapp
Screenshots
SN
MMS
Apps
Other
Yes
No

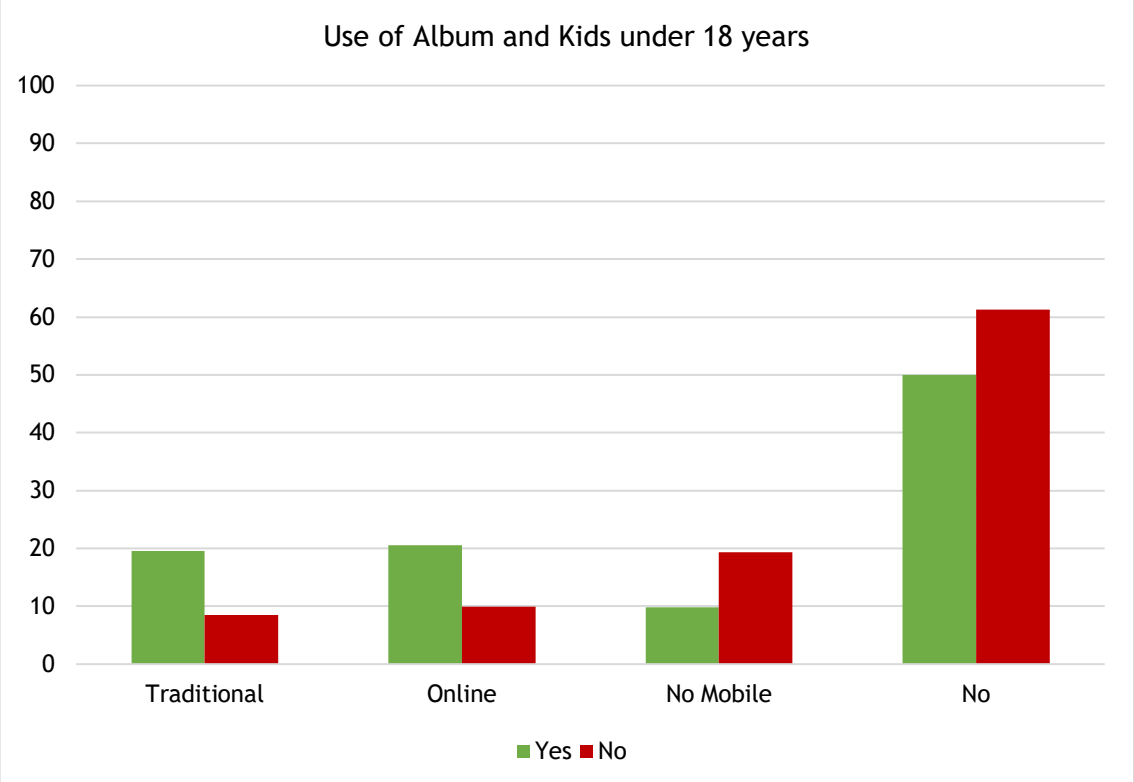

Authorship of the images and kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Me
Family
Extended Family
Friends
Celebrities
Unknown
Other
Yes
No

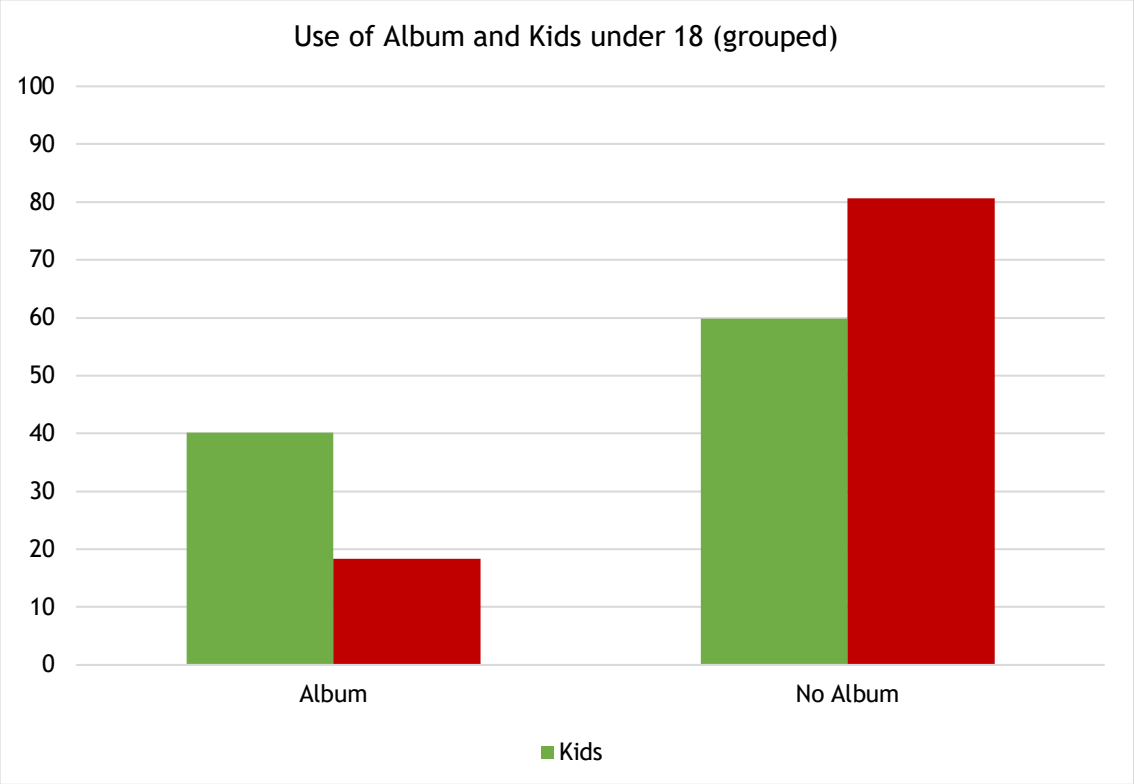

Storage of Images and kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Phone
Computer
Hard Drive
Cloud
SN
Print
Other
Yes
No

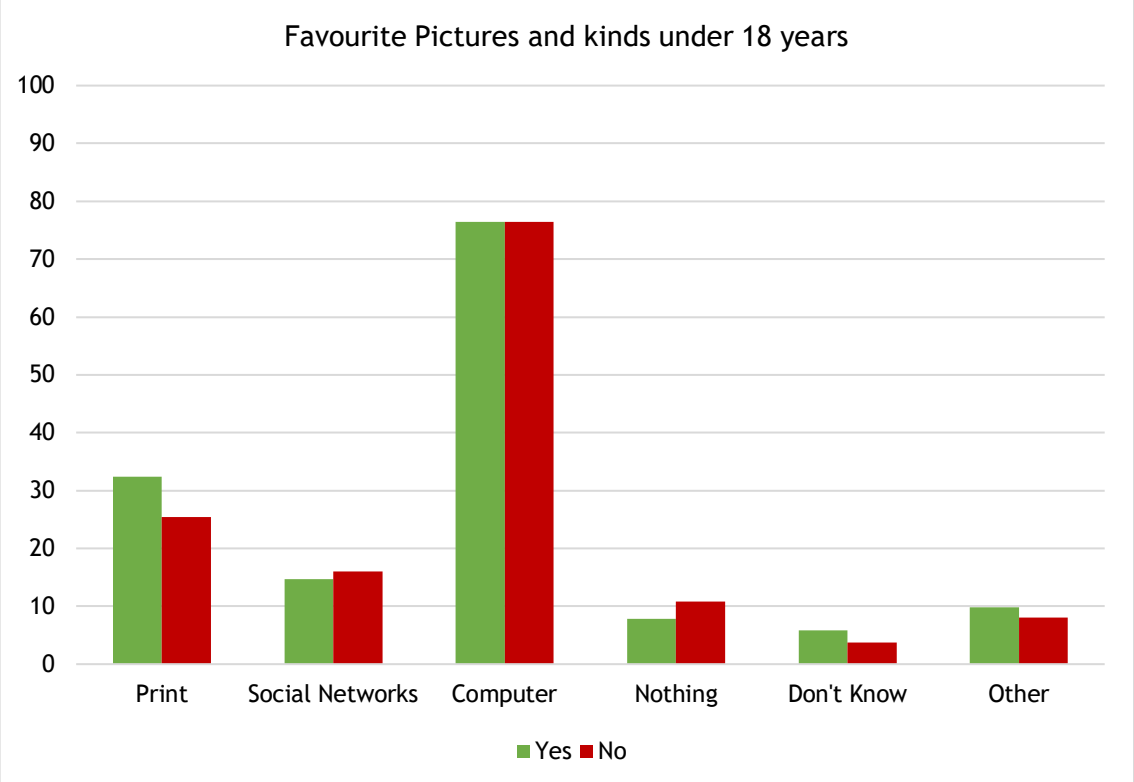

Use of Cloud and kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
OneDrive
Google
Dropbox
iCloud
None
Other
Yes
No

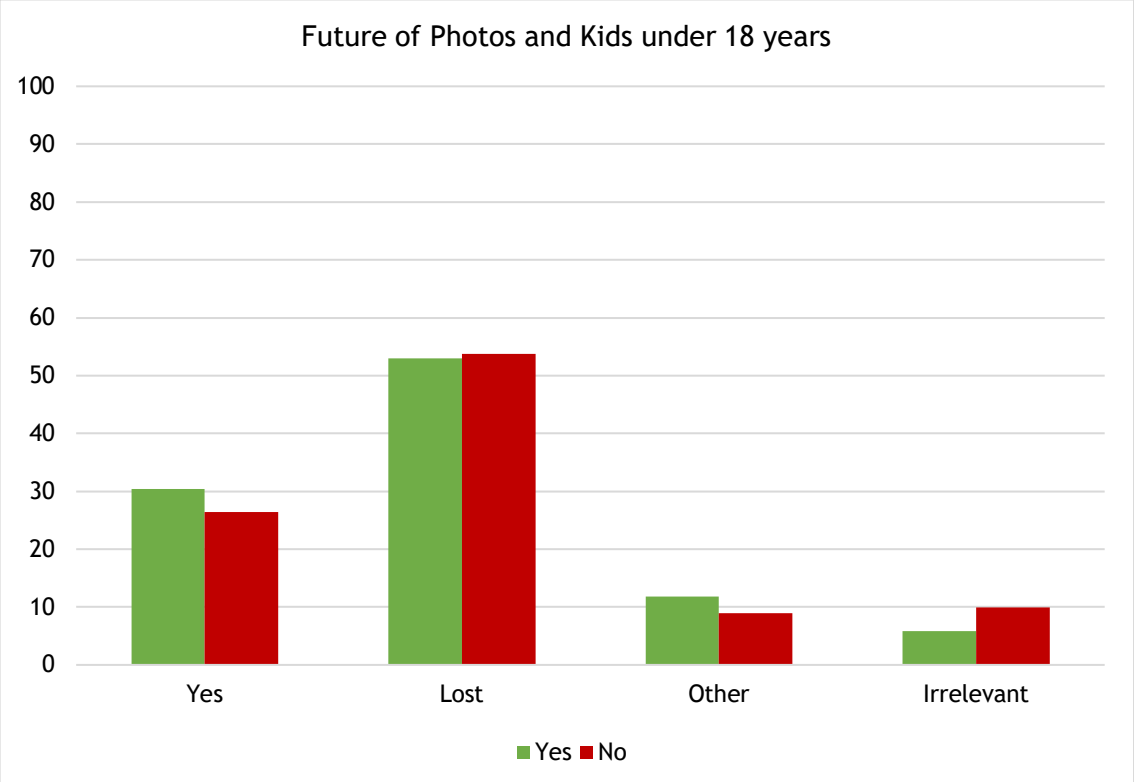

Use of Social Networks and kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Facebook
Instagram
Twitter
Pinterest
Flickr
None
Other
Yes
No

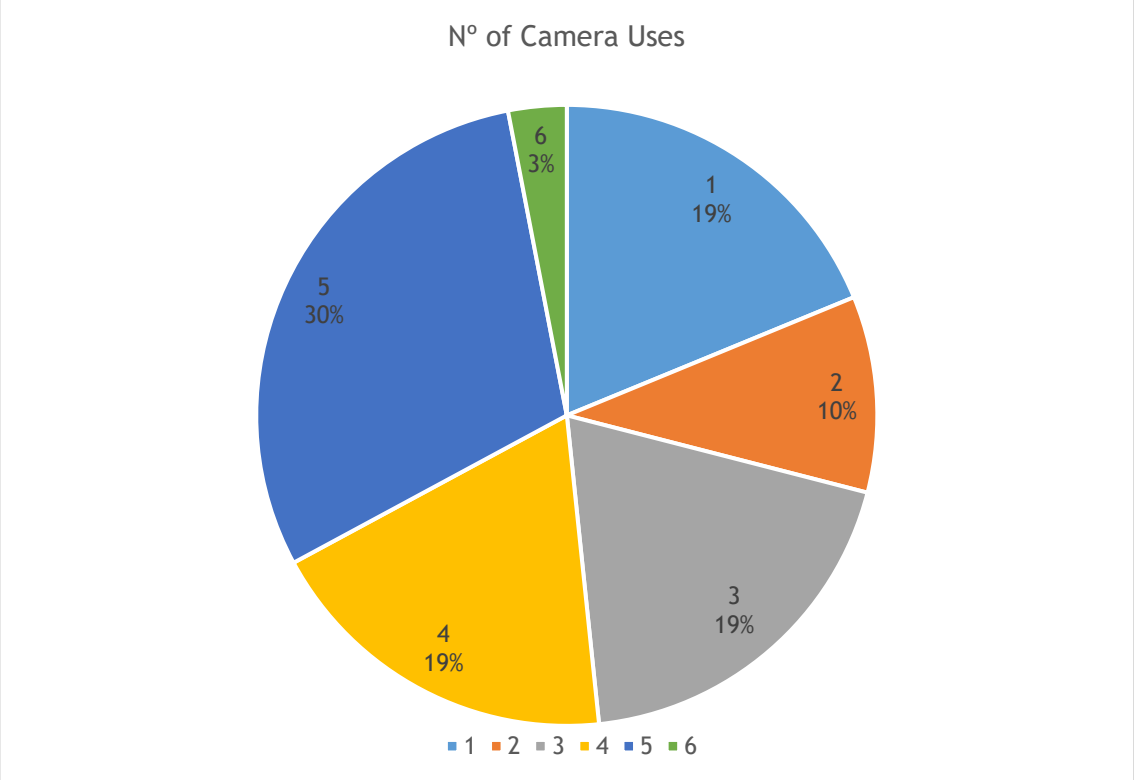

Review of photos and Kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Yes
No
Don't Know
Yes
No

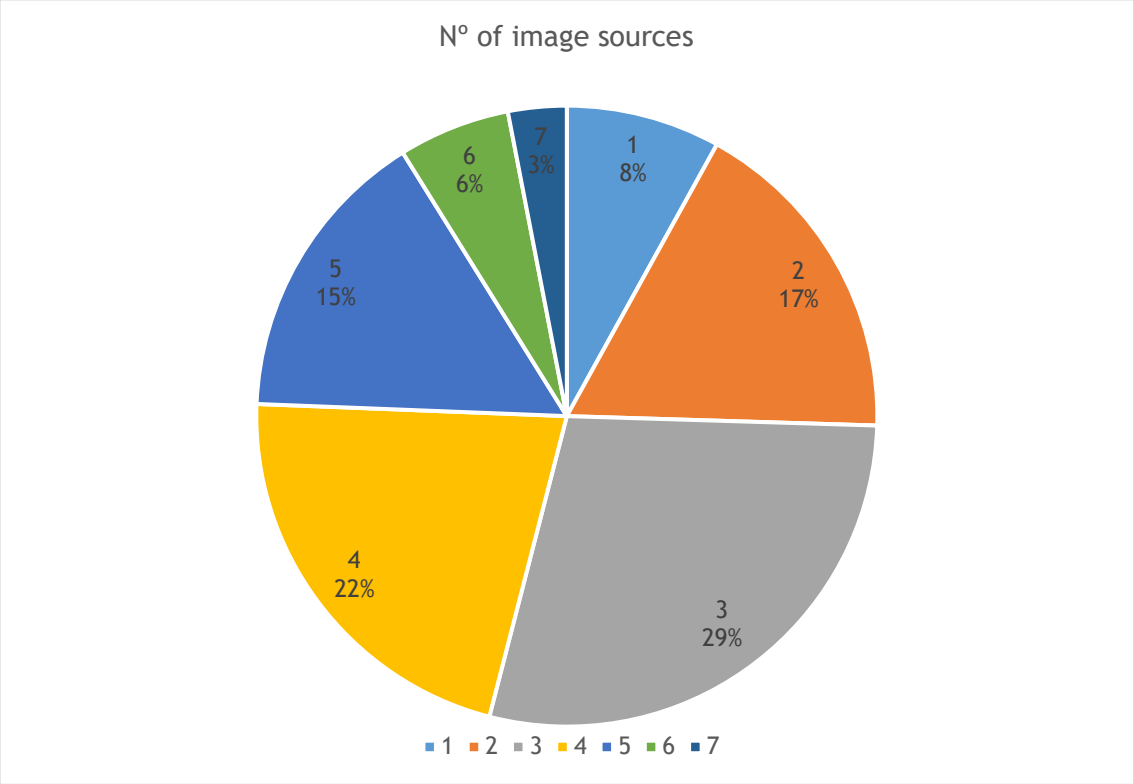

Use of Album and Kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Traditional
Online
No Mobile
No
Yes
No

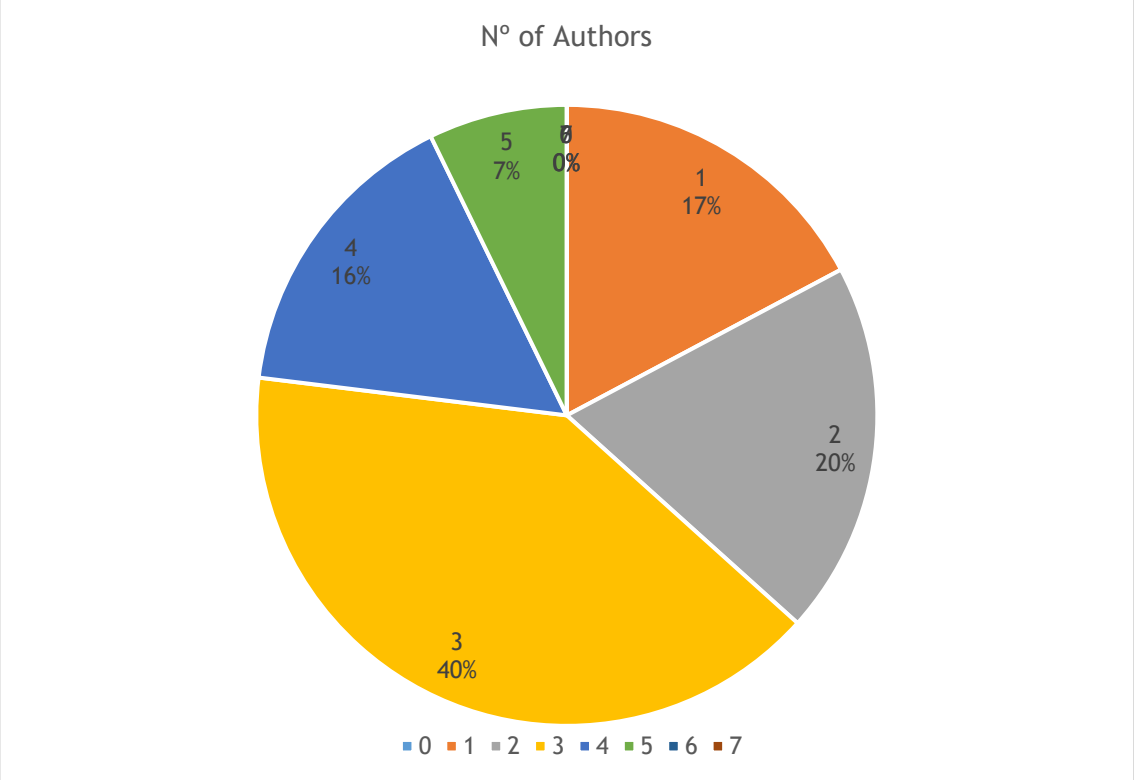

Use of Album and Kids under 18 (grouped)
100
90
80
70
60
50
40
30
20
10
0
Album
No Album
Kids

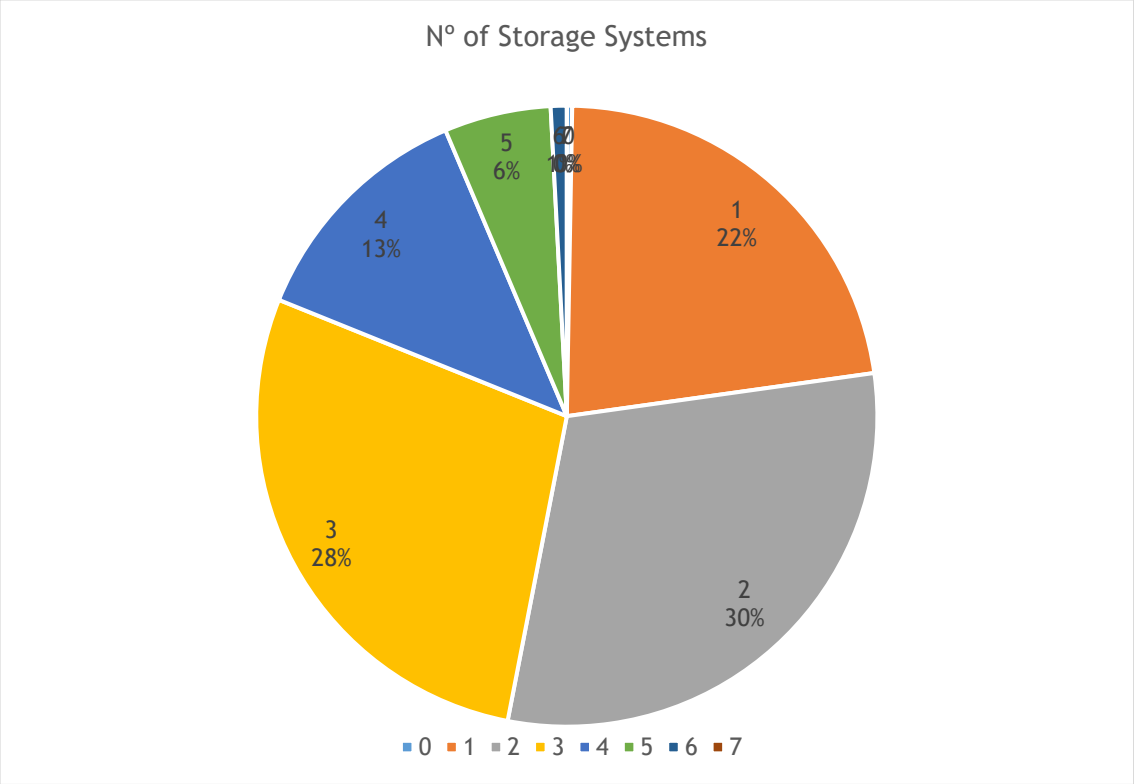

Favourite Pictures and kinds under 18 years
100
90
80
70
60
50
40
30
20
10
0
Print
Social Networks
Computer
Nothing
Don't Know
Other
Yes
No

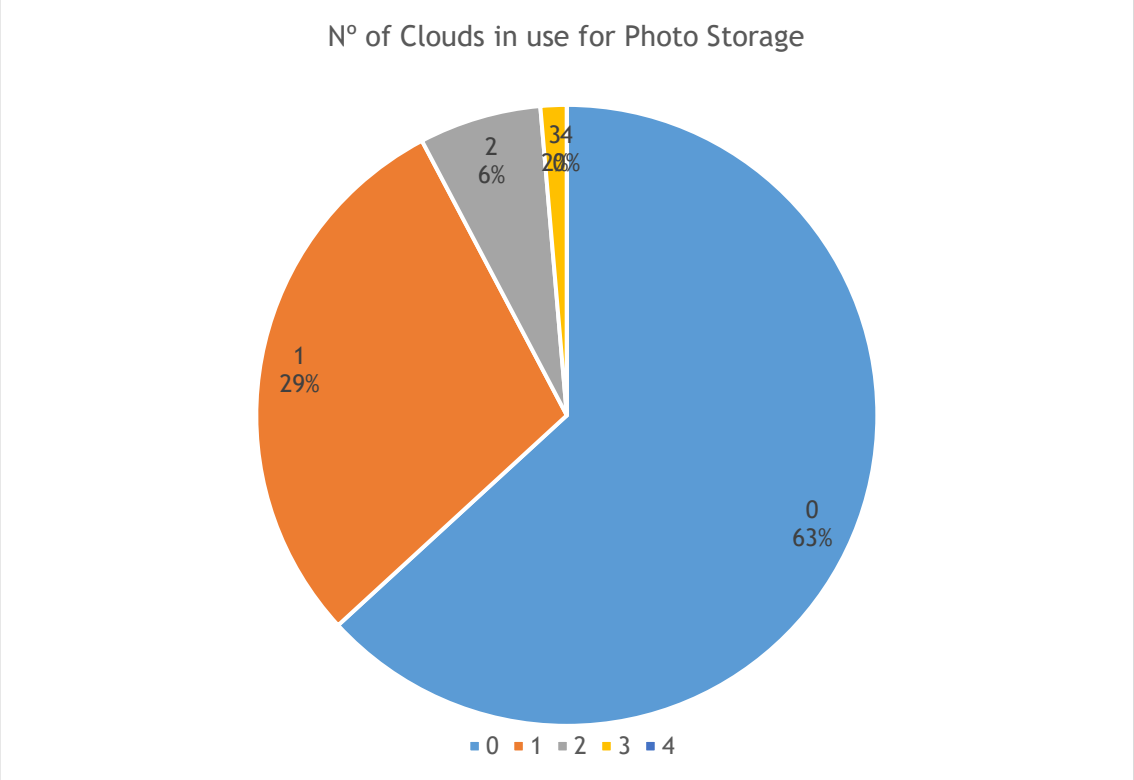

Future of Photos and Kids under 18 years
100
90
80
70
60
50
40
30
20
10
0
Yes
Lost
Other
Irrelevant
Yes
No

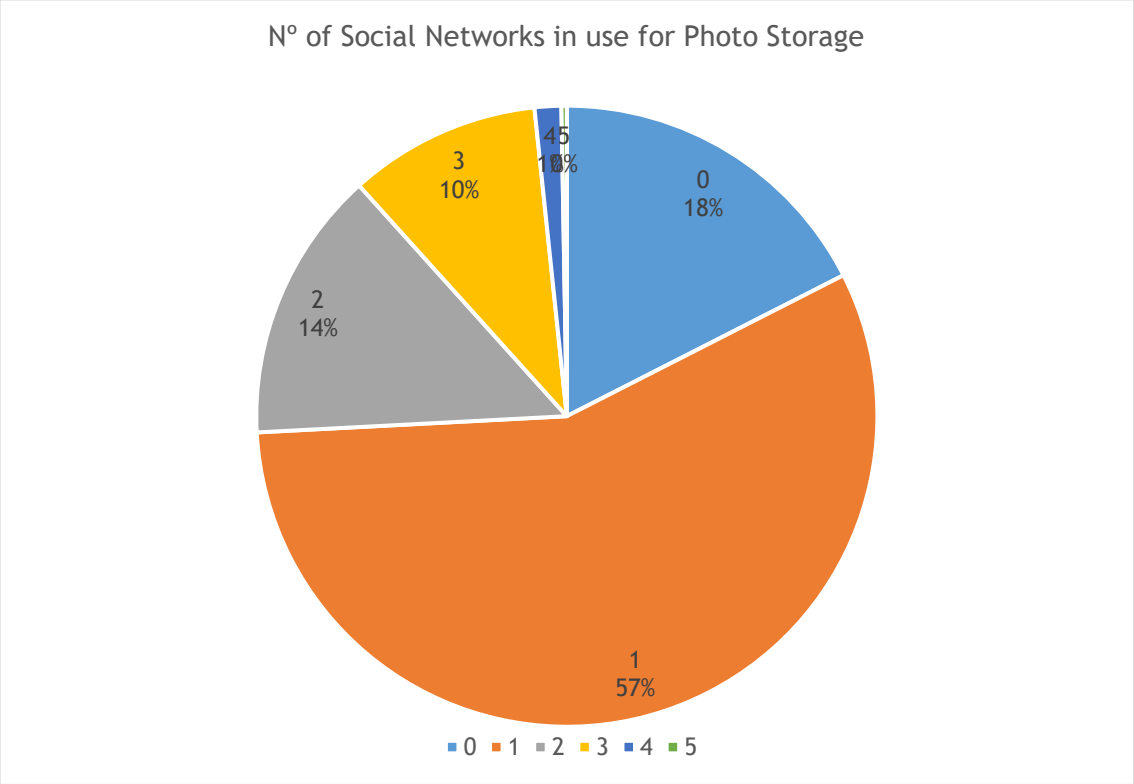

Nº of Camera Uses
6
3%
1
19%
5
30%
2
10%
3
19%
4
19%
1
2
3
4
5
6


Nº of image sources
1
8%
2
17%
3
29%
4
22%
5
15%
6
6%
7
3%
1 2 3 4 5 6 7


Nº of Authors
1
17%
2
20%
3
40%
4
16%
5
7%
0
0%
0 1 2 3 4 5 6 7


Nº of Storage Systems
1
22%
2
30%
3
28%
4
13%
5
6%
0 1 2 3 4 5 6 7


Nº of Clouds in use for Photo Storage
0
63%
1
29%
2
6%
0 1 2 3 4


Nº of Social Networks in use for Photo Storage
0
18%
1
57%
2
14%
3
10%
4
5
0 1 2 3 4 5